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PRACTICE WITH SCIENCE.

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1852.

These experiments, it is true, are not easy; still they are in the power of every thinking husbandman. He who accomplishes but one, of however limited application, and takes care to report it faithfully, advances the science, and, consequently, the practice of agriculture, and acquires thereby a right to the gratitude of his fellows, and of those who come after. To make many such is beyond the power of most individuals, and cannot be expected. The first care of all societies formed for the improvement of our science should be to prepare the forms of such experiments, and to distribute the execution of these among their members.

Von Thaer, *Principles of Agriculture.*

London:—Printed by William Clowes and Sons, Stamford Street.

CONTENTS OF VOL. XIII.

APPENDIX.

DIRECTIONS TO BINDER.

The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, which are in all cases to be placed at the *beginning* of the Volume: the lettering at the back to include a statement of the *year* as well as the *volume;* the first volume belonging to 1839-40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In reprints of the Journal, all Appendix matter (and in one instance an Article in the body of the Journal), which at the time had become obsolete, were omitted; the Roman numeral folios, however (for convenience of reference), being reprinted without alteration in the Appendix matter retained.

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

I.—*The Relations of Geology to Agriculture in North-Eastern America.* By JAMES F. W. JOHNSTON, F.R.S. L. & E.; Honorary Member of the Royal Agricultural Society.

THERE are two ways in which the relations of geology to agriculture can be viewed and considered: either broadly and generally, in regard to the agricultural character and capabilities of entire geological formations or groups of rocks; or locally, in regard to the connexion of the kind of fertility exhibited by this or that limited district or single spot with the kind of rock on which the surface rests. Of these two modes, the first or broadest is the most attractive, the most interesting in its conclusions, and the most satisfactory in the relations it establishes between agriculture and geology. The second is less simple, clear, and satisfactory. It is far more laborious to follow out also, and requires more knowledge of details in the investigator; but, at the same time, it leads to results which are directly practical and of immediate application.

In the present paper I propose to illustrate both, but especially the first, of these methods, by illustrations drawn from North-Eastern America.

A. GENERAL RELATIONS OF AGRICULTURAL CAPABILITY TO GEOLOGICAL STRUCTURE.

I. *On the Atlantic Sea-board.*—My first illustration I shall take from the Atlantic sea-board of the more western States of the Union.

If from the coast-line in any of the States west of the river Potomac—from the sea-shore of Virginia, for example, of either of the Carolinas, of Georgia, or of Alabama—a traveller proceeds inland till he reaches the first slopes of the Alleghany Mountains, he will pass over four regions which, even to the unprac-

tised eye, are most clearly distinct in the character of their soils and in the nature of their vegetable productions, whether natural or cultivated.

First. Rich muddy flats line the shore, intersected in some places by creeks and swampy hollows. To these low lands the negroes repair at the proper season of the year, and put in, tend, or reap the sea-island cotton and the rice, which here yield great returns. The white masters, or superintendents, visit them as rarely as possible, the climate in the hot season being rife with fevers fatal to the constitution of the white man. When these swampy flats are still in a state of nature, the swamp willow, the cypress, the swamp hickory, the green palmetto—the proud badge of North Carolina—the tall magnolia, the red maple, and the cotton-wood, form a distinguishing natural vegetation, rich and beautiful to the eye, but reminding the practised observer at once of a soil full of natural fruitfulness and of an atmosphere prolific in shivering ague and in depressing and rapidly wasting fever.

A few miles inland brings him to higher ground. The alluvial plain gradually rises a few feet above the sea-level, and dry, rich soils support a natural growth of hickory, oak, beech, magnolia, walnut and tulip trees, and of holly. Tobacco and sugar are the staple marketable crops, which the cultivator raises on these drier soils, where generations of exhausting culture have not already worn them out. They yield also large crops of Indian corn—the main food of the coloured labourers—to which the warmth of the climate is as propitious as the soil.

Second. Pursuing his journey towards the hills, after twenty miles or thereby—a breadth which varies in different parts of the coast—he reaches the edge of the drier alluvial plain, and ascends a low escarpment of yellowish sand. He now finds himself in the midst of forests of unmixed natural pine, covering a belt of barren sand generally unfit for cultivation, and which for hundreds of miles girdles in the lower plain of rich land he has already crossed. The worthlessness of this pine region for the purposes of the cultivator is illustrated by the history of that portion of the belt which runs through the State of Georgia. After the settlement of the boundary line between Georgia and Florida, the State Legislature of Georgia passed an Act ordering all the unsold lands of the State, after being surveyed, to be divided by lot among the resident population. The cost of surveying and other expenses imposed a charge of two cents an acre on these lands, which fell to be paid by the allottees. But a great many of those who drew the pine barren lots refused to take out their grants, thinking them not worth the two cents an acre they had to pay for them. The State Legislature, therefore, subsequently

ordered that all the land of this kind which was unclaimed after a certain period should be sold at four cents an acre to whoever would buy it. Large speculations were in consequence made by individuals and companies, chiefly with a view to cut down and sell the timber. The lumber merchants from the north-eastern States were conspicuous among these speculators ; and I had the fortune to travel for some distance with a gentleman who, among other information, told me he was one of a small party who had bought no less than 190,000 acres of this Georgian barren in one locality, with the confident expectation of making much money by the sale of the lumber.

The species of pine with which this barren is covered changes as we proceed towards the south and west—probably from the change of climate and exposure. In North Carolina it bears principally the Pitch pine (*Pinus rigida*), which yields large supplies of turpentine. This and the timber are shipped from the port of Wilmington in that State. In Georgia, again, the prevailing tree is the Yellow pine (*Pinus mitis*), which yields a harder and more valuable timber than the Pitch pine. The chief difference, as I was informed, is that the sap or soft heart-wood in the Yellow pine is much less in diameter than in the Pitch pine, and thus the proportion of hard resinous wood in trees of the same size is much greater in the former than in the latter.

Third. Farther inland the traveller ascends another terrace, and at once escapes from the forest into the open treeless prairie, where, far as the eye carries him over the flat, only natural grasses wave in the wind, unless where settlements have been made, and the arts of husbandry have introduced a new vegetation. The thin soils of this attractive plain rest upon a rotten chalk or chalky marl, and, like the soils of our chalk downs, are absorbent of moisture and naturally dry. They produce a sweet herbage, grateful to the cattle, and yield fair crops of wheat while still in a virgin condition. The variety known in the market by the name of Georgian wheat is grown on these chalky prairies. They are attractive to the settler because they can be converted into farms without cost. There is no forest to fell. As much land as can be skimmed with the plough may be sown with grain year after year by the first settler, and the aid of a reaping machine makes him almost independent of labour when the time of harvesting comes. It is upon plains like these—so easy to till and so bare of trees—that in published accounts of some of the States we read of single fields of wheat containing from 400 to 700 acres of waving grain,* and from which a crop of ten or

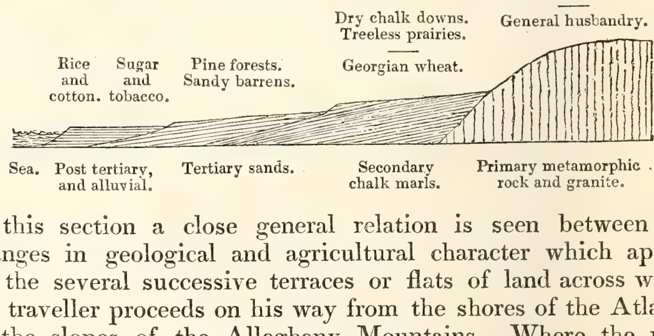
* I have never myself seen any of these large fields, probably because I was never upon any of these prairies where they were to be seen. I was told by a

twelve bushels an acre leaves a profit upon the labour and capital expended. But the thin black virgin soils which cover them soon deteriorate. Deeper ploughing does not permanently restore them, and the knowing cultivator now sells his *improved* lot to a new comer, and betakes himself to another virgin tract which the tide of emigrant population is only beginning to reach.

Fourth. Crossing the prairie or chalk down, he comes again to a sudden rise in the country, over which cheerful forests of *broad-leaved* trees extend—of oaks, hickory, &c., and a scattered admixture of pines. He is now on the older rocky formations, of which the first slopes of the Alleghanies consist. Mica-slate, gneiss, and granite, here mingle their débris to form a characteristic red, clayey, but friable soil, which crumbles readily, and, from the nature of the climate, admits of a husbandry approaching more to that of our English farmers.

The marked features of soil and vegetation which our traveller thus perceives entirely coincide with as distinctly marked geological features. This is seen in the following section of the coast-line in question, from the sea to the mountains. The letterpress below the section indicates the geological formations—that placed above it indicates the natural vegetation and the crops which grow best upon each.

No. I.



In this section a close general relation is seen between the changes in geological and agricultural character which appear on the several successive terraces or flats of land across which the traveller proceeds on his way from the shores of the Atlantic to the slopes of the Alleghany Mountains. Where the most recent or alluvial loams and rich clays end, there the tobacco, Indian corn, and even wheat culture, for the time, ends also. The tertiary sands belong to a more ancient epoch, and to them are limited, by a strictly defined boundary on each side, the dark pine forests which are so striking a feature of the country. On the older chalk, again, the treeless prairie and flinty wheat country is as distinctly limited by the formations on either hand; and

Michigan farmer who invited me to visit him, that he had 400 acres under wheat, and reaped with a machine. The average produce of the whole of this State of Michigan is only $10\frac{1}{6}$ bushels of wheat per acre.

beyond this, again, the changed forests and cultivation of the higher country are determined by the change in nature and in age which the rocks of this region exhibit.

It is only necessary to observe further that the width of these several belts of land varies in different parts of the long Atlantic coast-line. The alluvial border is broadest in the southern States and along the Gulf of Mexico, the pine belt probably in Georgia, and the chalk marl in Alabama and Mississippi. The latter also—the chalk—is by no means continuous. It forms only a narrow belt in New Jersey and Maryland—almost disappears in the Carolinas—is known only in patches in Georgia, but becomes again broad and continuous in Alabama. Still, wherever, along this great distance, any of these formations occur, and of whatever extent they may at that place be, they always exhibit the same general characters of soil, of natural vegetation, and of agricultural capability, in so far as the climate of the place permits.

It is, indeed, very remarkable how uniform in this respect the same geological formation is sometimes found to be, not only in the same country, but in different countries at great distances from each other. I have already alluded, for example, to the natural dryness of this chalk belt on the Atlantic border of the United States. The scarcity of water experienced by those who reside upon it is often great. Every one knows that the same is true of our own chalk region in England—that in very many places wells are sunk through it with the view of reaching water, and that in London great depths are gone to, and at a vast expense, through the London clay and the chalk, before water can be obtained. In the Paris basin the chalk is equally dry, and there are very few who have not read of the remarkably deep well at Grenelle in the neighbourhood of Paris, which, like the less profound London wells, has been sunk to the sands below the chalk, and with similar success.

So, in Alabama, on this formation water is only to be obtained by sinking through the chalk. Three years ago there were already about 500 wells in that State, sunk to a depth of from 400 to 600 feet, there being one generally upon each plantation. And thus, while the climate there, as elsewhere, determines the general character of the vegetable produce, what kind of plants under the meteorological conditions can arrive at perfection, and also the race of men by whom that labour can be best performed,* yet the geological structure determines whether or not any crops shall be able to grow at all, and, of the kind of plants suitable to the climate, which can be profitably cultivated upon its actual

* Cotton is the staple market crop of Alabama. The State contains by the last census (1852) a population of 779,000, of whom 344,000 are slaves.

surface. But in the present case the reader will perceive that the geological structure determines more. In such a climate, and with a soil so naturally arid, abundant water is indispensable; but this can only be obtained by deep boring performed at a great expense. The geological conditions, therefore, confine the possibility of cultivation to men of large means, and, in present circumstances at least, necessarily exclude all petty farming and the subdivision of the land into small holdings. They determine, in other words, the social condition of the people. This single illustration is enough of itself to satisfy any impartial person of the close general relation which exists between the geological character and the agricultural capability of a country, and of the broad general deductions in regard to its possible future prosperity—in a rural sense—which may be drawn from a knowledge of its geology. I believe it is partly under the influence of this conviction that the Senate and Congress of the United States have so often and so cordially voted large sums of money for the purpose of investigating and mapping the main geological features of the new States and territories which from time to time have been admitted into the Union.

II. *Relations of Geological structure to Agricultural capability in Western New York.*—I take my second illustration from Western New York, partly because this has long been celebrated as a rich wheat-growing district; partly because the relations we are studying are here really very interesting; and partly because this locality will give me the opportunity of showing, by a more detailed example, the intimate connexion which subsists between the economical value of a region in the agricultural, and the composition of its rocks in a geological, sense.

The section of the country along the Atlantic border, which formed the subject of the preceding illustration, terminated inland with the primary rocks of which the first slopes of the Alleghanies consist, and which, by their crumbling, form red friable soils, clothed with mixed, chiefly broad-leaved, trees.

The primary stratified rocks are there generally tilted up, squeezed together, as it were, and standing on edge. They thus occupy but little space, so that a mixed soil of a common character, derived from their intermingled fragments, overspreads them all.

But Western New York presents us with a most favourable opportunity of studying the special agricultural influence, in detail, of each individual member of whole groups of rocks. That subdivision of the primary rocks, distinguished among European geologists by the name of Silurian, is there flattened and spread out over a large extent of country; and the several beds of this

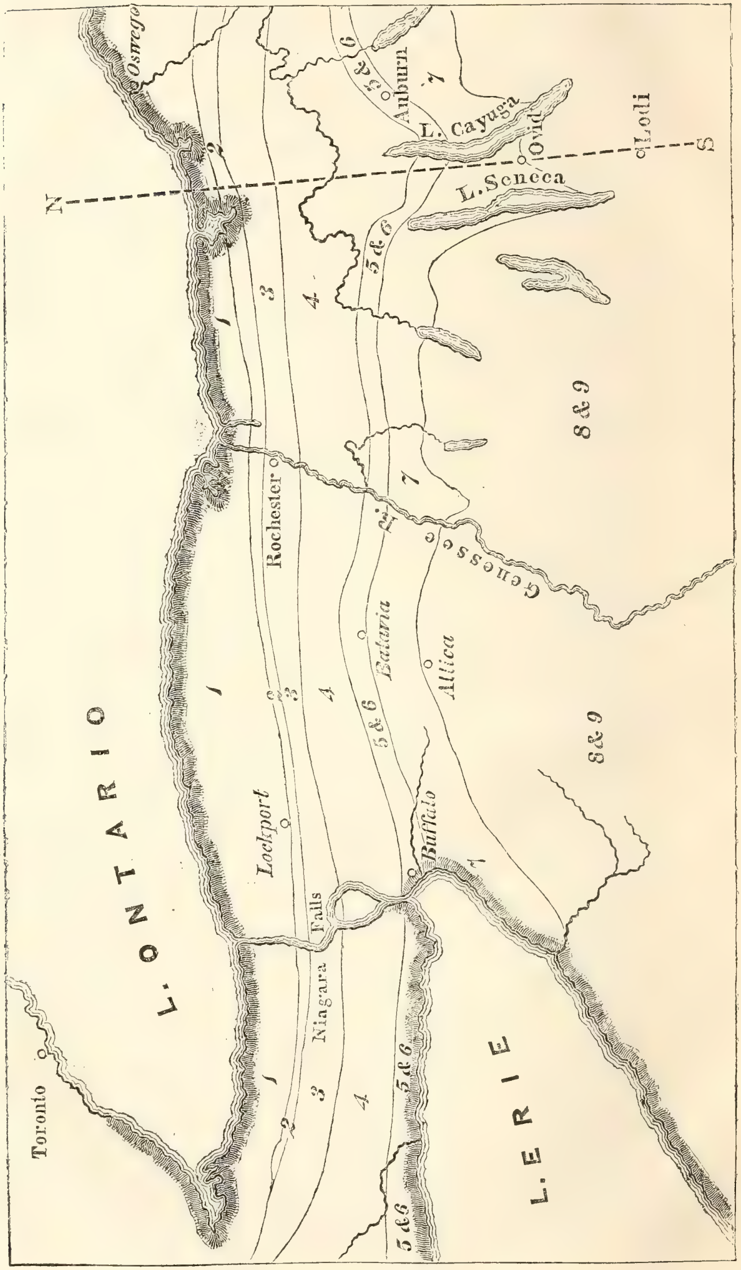
subdivision—partially overlapping and rising above each other in a succession of small but distinct terraces of greater or less breadth—plainly exhibit to the eye of the observer the chemical characters of each, the kind of soil which in crumbling it naturally produces, and the special effect it has on the agricultural capability of the surface that rests upon it.

The country to which I here refer extends along the southern shores of Lake Ontario, from beyond Buffalo, at the foot of Lake Erie, on the west, to Oswego, near the foot of Lake Ontario, on the east. Its length is about 180 miles, and its mean breadth from Lake Ontario towards the south about 30 miles. The district rises as we proceed southward from the Lake, sometimes by sudden starts over rocky escarpments, but generally in a gradual manner, till it attains a height of 600 or 700 feet above the Ontario. Farther south, towards the Pennsylvanian border, the high land attains an elevation in some places of nearly 2000 feet. The woodcut (p. 8) exhibits an outline of its geographical position and geological structure.

This outline map shows the relative position of the Lakes Erie and Ontario, the discharge of the waters of the former into the latter by the Niagara river, and the drainage of the high southern country towards the borders of Pennsylvania by the Genessee river, which falls into Lake Ontario below Rochester. The lines which run from east to west indicate the boundaries of the several rocky formations of which the country consists; all, except that marked 8 and 9, belonging to what is called in Europe the Silurian system of rocks. The area or strip of country covered by each formation is represented by the numbers 1, 2, 3, &c., in the ascending order of their superposition. They form, as I have above stated, a succession of strips, belts, or terraces, of greater or less breadth, from the lowest (No. 1), on the banks of the Lake, to the highest (No. 9), which covers the interior of the country. The names given by the New York geologists to these several rocks are as follows :—

No. 1. The Medina sandstone; No. 2. The Clinton group; No. 3. The Niagara group ; No. 4. The Onondaga salt-group ; Nos. 5 and 6. The Helderberg group ; No. 7. The Hamilton group ; Nos. 8 and 9. The Portage and Chemung groups.

The broadest belts, as will be seen from the map, rest upon the Medina sandstone and on the Onondaga salt-groups. Of course I do not compare any of these belts in area with the extended surface occupied by Nos. 8 and 9, which bound on the south the low and fertile region to which my observations will chiefly apply. The mineralogical character of these several groups of rocks, viewed in connexion with the nature of the soils



L. ONTARIO
L. ERIE
Toronto
Oswego
Auburn
L. Cayuga
L. Seneca
Ovid
Lodi
Rochester
Genessee R.
Lockport
Batavia
Attica
Buffalo
Niagara Falls
N
S
8 & 9
5 & 6

they form, afford the illustration to which I am desirous of drawing the attention of my readers.

No. 1, *the Medina Sandstone*, consists of layers of brownish or red sandstone, intermixed with layers of reddish shaly or shivery clay. These yield the red soils of the low flat belt which skirts the southern shore of Lake Ontario. At its eastern extremity this rock contains few partings of clay, and produces therefore poor sandy soils of comparatively little value. Over much of these poor sands natural pine forests still extend, as the traveller sees when he steams along the Lake from Rochester to Oswego. But, as is occasionally the case with other sandstones, the partings of clay increase in number and thickness towards the west, producing first sandy loams, and finally rich clay loams well adapted to the growth of wheat. Hence this same formation, which at the east end of the Lake affords only poor hungry soils, yields between the mouths of the Genessee and the Niagara rivers some of the richest wheat-lands in the State.

No. 2, *the Clinton Group*, forms a very narrow zone, which is nearly concealed by the débris of the rocks which lie immediately above and below it. This group consists of green and blue shales with limestone intermingled, altogether from 60 to 80 feet in thickness. They are soft and thin, and have therefore been washed away by the ancient sea nearly to the edge of the hard thick limestone of No. 3 which lies above it. The admixture of the fragments of this Clinton formation has produced a surface of excellent wheat-soil. It forms a very narrow terrace of calcareous clay, sloping with a gentle inclination towards the lake. The dotted line N S in the map represents the line of the cross-section (No. III.) given in page 18. A glance at the map will show that along the line of this section the zone of the Clinton group is broader than it is anywhere towards the west, reaches a breadth in fact about equal to that of the Medina sandstone below, or of the Niagara limestone above it. It is necessary to notice this fact, otherwise this cross section would appear to be inconsistent with the general indications of the map, in which the Clinton group forms usually a very narrow strip indeed.

No. 3, *the Niagara Group*, consists of an enormous thickness of limestone above, resting upon a great thickness of dark blue crumbling shales below. At Niagara, where the river falls, the limestone has a thickness of 130, and the shale of about 80 feet. The shale alone, where it comes to day, produces stiff blue clays, which, from the sloping nature of the surface, are generally dry and susceptible of culture. Like many of our own still untouched clays at home, however, they are to be hereafter rendered greatly more valuable by the introduction of our British system of thorough drainage. This mode of improvement is

beginning now to attract a considerable degree of attention among intelligent and well-educated farmers in the older States of the Union, and nowhere more, I believe, than among those who cultivate this naturally favoured region of Western New York. Where the débris of this Niagara shale is mixed up with those of the Medina sandstone and Clinton groups—which is frequently the case along the lines of junction—the admixtures are said to produce soils of "unequalled fertility." This fact illustrates the observation of all agricultural geologists in every country, that the economical value of the land almost invariably increases along the line of junction of two geological formations; provided that coverings of far-transported drift do not prevent the subjacent rocks from exercising their legitimate influence upon the nature of the soils that cover them. The overlying Niagara limestone, where it is uncovered with drift, has crumbled down into thin open soils which produce wheat, but are better adapted for Indian corn, or for the turnip husbandry, should this region ever become familiarized to it. The surface of the limestone, however, is generally overspread with fragments of the underlying more crumbling shale which have been drifted over it, and thus the belt No. 3 is, for the most part, overspread with deeper and richer soils than would have resulted from the decay of the lime-rock alone.

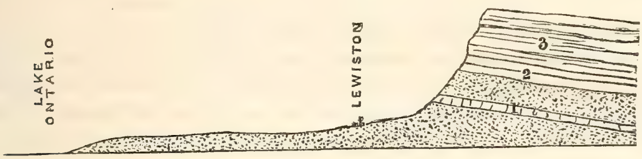
It will be seen in the cross-section (No. III.) given in page 18, that the rise from No. 2 to No. 3 is by a sudden step or cliff. This cliff is comparatively low towards the east, where the section is taken, but increases in height towards the west. This is owing to the circumstance that the bed of limestone increases in thickness in proceeding from the east towards the west. In Wayne county, where the section is taken, it is only 30 or 40 feet thick; while on the Niagara river, above the rapids, it is 164 feet, and it still increases in thickness as we proceed farther towards the west, along the northern shores of Lake Erie. This is owing, most probably, to the increasing depth in that direction of the ancient sea in which this limestone was deposited.

This increasing thickness exercises an influence upon the agricultural character of the country occupied by the Niagara group in its western range, but its most sensible and striking effect in Western New York is on the physical features of the district. The outcrop of the limestone forms a long cliff or escarpment, which skirts the whole southern edge of the lake, and presents to the traveller most beautiful and extensive views of the flat country below and far over the waters of the lake beyond. From the Genessee to the Niagara rivers this cliff is a characteristic feature of the country, and is familiarly known by the name of the "mountain-ridge." Over this escarpment of

the limestone the Genessee and the Niagara, among other rivers, precipitate themselves, producing those magnificent falls which have given celebrity to Niagara, and an unlimited water-power and most rapid rise to the city of Rochester.

The following section will give an idea of the appearance of the mountain-ridge in the steepest and boldest parts of its course, and will show how it overlooks the flat plain of the Medina sandstone and the waters of Lake Ontario.

No. II.



In this section the dotted mass above and below No. 1 is the Medina sandstone, No. 2 is the Niagara shale, and No. 3 the overlying thick-bedded limestone. It is taken behind the town of Lewiston, at the mouth of the Niagara river, on what is called the American side. The view which the spectator enjoys from the top of the escarpment at this spot is worth going a long way to see. Sheer down one looks over the scattered town of Lewiston, upon the broad flat forest-lands stretching many miles back from the lake, and eastward along its shores farther than the eye can reach. Here and there only, at the time of my visit, in all this distance a clearing appeared upon this often marshy flat. Right in front lay the endless lake and its occasionally bolder shores beyond, with now and then a straggling sail or a distant steamer's smoke, all mellowed and blended by a four o'clock sun. I was much struck both with the extent and with the unsubdued wildness of the prospect, when I unexpectedly reached the cliff on my way from the falls; and I could not help thinking how some two centuries hence, when all this low plain before me shall have been cleared, drained, and cultivated—when smiling villages and cheerful homesteads, and scattered flocks and herds overspread its surface, and the blue smoke may be seen dying away from many chimneys as the Sabbath bell draws the gathering people towards the frequent house of worship—how many in those days for broad pictures of natural beauty, intense with countless little episodes of still life, will yet frequent this mountain ridge when the noise of the neighbouring cataract has wearied them, and softer scenes are wished for to calm and compose their fevered spirits.

No. 4, *the Onondaga Salt Group*, derives its name from the brine-springs which issue from it in various parts of this western

region. Salt is largely manufactured from the water of these springs, especially at Syracuse, where the annual produce amounts to 125,000 tons, about a fourth of the whole annual consumption of the United States.

This group of rocks consists in descending order of,—

a. Green calcareous shales and shaly limestone, rich in magnesia.

b. Calcareous shales and impure limestones, containing deposits of gypsum.

c. Green marls and shales, and shaly limestones.

d. Green marls, with bands of red marls.

The formation as a whole is crumbling, friable, and rich in calcareous matter. The soils it produces are consequently rich, free, and easily worked. It has an average thickness of about 1200 feet, and forms a belt of generally level but undulating land, with a gentle inclination towards the lake. It runs east for upwards of 100 miles beyond the line of section N S in the map, and westward across the Niagara river, round Lake Ontario, and far into Western Canada. An inspection of the map will show that this belt occupies a large proportion of the whole area of the district. Its average breadth is 10 or 12 miles, the latter being its breadth on the Niagara river. In the line of section N S, its breadth suddenly expands to between 20 and 30 miles. Towards the east it narrows off, and disappears as we approach Schnectady and the Hudson river, while in Western Canada it expands to a maximum breadth of about 80 miles.* In this western region, therefore, the Onondaga salt group forms a large area of rich land, profitable in Indian corn, but especially in wheat.

During a stay of a few days at Syracuse, I visited the farm of the Hon. Mr. Geddes, a member of the State senate, and, under his guidance, had the satisfaction of surveying a considerable extent of this formation, so very interesting in its geological, agricultural, and economical relations. This gentleman is the owner of 300 acres of the best quality of land which occurs on this formation, and, like nearly all the owners in this country, lives upon and farms his land himself. The soil I found to be a light-coloured calcareous clay, which crumbles readily and never bakes. It is generally shallow, and rests on one of the green shaly rocks above mentioned. This shale crumbles readily in the air, and, by exposure, becomes paler in colour, forming the light-coloured soil of which the farm consists.

This neighbourhood, in its general aspect, appeared to me more like a part of Old England than of a newly cleared or settled country. Of Mr. Geddes's 300 acres, 270 were in arable

* See some additional remarks on this point in the concluding paragraphs of the present paper.

culture, and comfortable houses and good buildings of other kinds were seen on most of the farms I passed. The size of farms is here generally from 100 to 300 acres, and these, with the buildings upon them, usually sell at 50 to 60 dollars an acre. At this price Mr. Geddes expressed to me his opinion that it was the cheapest land in the States *for those who have capital to buy it.* By those, of course, whose whole wealth consists in their bodily strength and industrious habits, the wilderness land of the more western regions is alone attainable.

I give, as an illustration of the capability of this very best land, the following statement of the produce per acre, as furnished to me by Mr. Geddes. This soil is of a very useful kind, producing all sorts of grain crops, though not of equal quality. The yield per acre is,—

Wheat . .	18 to 35	bushels, of	60 lbs.
Barley . .	20 to 55	,,	48 lbs.
Oats . . .	40 to 100	,,	32 lbs.
Indian corn . .	50 to 80	,,	56 to 60 lbs.
Potatoes . .	100 to 300 bushels.		

It is least adapted, he said, to the growth of potatoes—which is more probably owing to the climate and the great summer heats than to any defect in the soil. Turnips are as yet but little grown, and the feeding of stock is not much attended to.* An average weight of 32 lbs. a bushel does not indicate a climate well suited to the oat crop. As a general rule indeed the climate which ripens Indian corn well rarely produces a crop of heavy oats.

The fact that this land has been ploughed for fifty successive years without receiving any manure will give the reader an idea of its innate richness. I walked with Mr. Geddes over two fields which have never been manured during the fifty years which have elapsed since his father first cleared them, and he thinks the land as good as ever it was. It yields from 50 to 60 bushels of Indian corn, and in 1848 it gave 30 bushels an acre of wheat. The soil consists, for the most part, of crumbling fragments of the green shale. When the older land appears to become exhausted the plough is put in a little deeper, so as to bring up a little of the crumbling rock (green shale). It is then said to produce wheat as abundantly as before.

The most sceptical as to the influence of geological structure upon agricultural capability can scarcely doubt after such an illustration as this.

The rotation on this farm was—1. Indian corn after lea, with

* When the necessity for manure becomes more urgent to the land, the feeding of stock will no doubt take in American the same place it occupies in English agriculture.

manure, if any is applied; 2. Oats; 3. Barley or Pease; 4. Winter Wheat with seeds in spring; 5. Grass, cut twice for hay; 6. Grass pastured with sheep and milch cows.

If the land be foul, it is now summer fallowed and sown with wheat, followed by seeds as before, after which Indian corn comes in again. If it is not foul, the rotation commences with Indian corn immediately after the two years' grass.

On soils derived from this extraordinary green shale, such severe—what we should call scourging treatment—may be continued a great many years with apparent impunity; although it is seen even here to tell very soon on land of inferior quality. But in this naturally rich land also its effects become visible at last. Hence it is that this celebrated wheat region of eastern New York AS A WHOLE is gradually approaching the exhausted condition to which the more easternly wheat growing, naturally poorer districts, had earlier arrived. Of course where the subsoil or subjacent rock is so full of natural fertility as this green shale is said to be, the exhaustion can only be superficial, and fertility may again be restored to the surface soil. But to do this will require both a more skilful and a more expensive system of husbandry—conditions which manifestly imply that crops can never again be raised so easily or so cheaply as during the early and virgin freshness of this deservedly lauded district.

Monroe county is in the centre of this district. The Genessee river runs through it, the city of Rochester stands in it, it embraces a large portion of the richest land in the Genessee valley and on the Onondaga salt group, and the corn averages of this county, as published by the New York State Society, are higher than those of any other county in the State. It may be supposed therefore at the present moment to be the most fertile. Now the averages per acre of Monroe county are as follows:—

Wheat . .	19½ bushels	Indian corn .	30 bushels.
Barley . .	19 ,,	Potatoes .	110 ,,
Oats . .	32 ,,		

For a highly and deservedly lauded, fertile, wheat-growing district, the pride of the State of New York, the happy home to which the longing eyes of British and Irish agriculturists have long been directed, these are but low averages. Either the land is not so good as it has been called, or it is, and has been, badly treated. The general treatment has certainly been bad, but as surely large portions of the land are naturally very good, and may still be made very productive. But if they can, it must be, as with us at home, by the application of more skill and by a more prudent husbanding of the natural riches which the soil contains. The trouble of preparing, collecting, and applying manures must not henceforth be thought too great for a free and independent

North American farmer. This is well understood now by the leading promoters of agricultural improvement both in the United States and in the British Colonies. But in this district of Western New York they feel the influence upon local prices of the great importations of wheat and flour from the new States west of Lake Erie. The tide of this commerce in grain has now turned in direction. Instead of sending westward from Buffalo its thousands of barrels of flour, as it did in former years, New York now yearly receives from the west, through the same port, its hundreds of thousands of casks of flour and of bushels of wheat. So that, besides the improvements which the advance of knowledge suggests, self-interest is now urging the farmer of New York to the adoption of wiser and better modes of culture. "What," said the President of the Oswego Agricultural Society, in his address at the close of 1850—"What, I ask, is to meet this competition of the west, but greater skill and care in the mode of agriculture?" This is precisely the language which speakers and writers in our own country have of late years been almost daily addressing to British farmers.*

Nos. 5 and 6. *The Helderberg Limestones and Sandstones* (5), rise immediately behind the Onondaga salt group. Where I drove along the edge of this limestone with Mr. Geddes it formed a high escarpment, from which the view of the flat lands below, and of the country towards the lake, was beautiful and extensive. Though far from what it was half a century ago, this great stretch of undulating plain still seemed strange and savage to an eye accustomed to the finished and artificially picturesque appearance of an English landscape. Swamps and lakes, and rude natural forests, with intervening tracts of land under waving corn, remind the spectator how much nature yet rules, how long human industry must patiently labour still before the asperities of a new country can be rubbed off, how many generations of the enterprising men who now possess it must still toil and adorn this fine land before it will smile at their feet like that which their forefathers left.

At this limestone the natural richness of the country as a wheat region begins to fall off. The soil upon the limestone itself, and upon its subordinate sandstone, is often thin, resting on a hard rock, but, where it happens to be deep, it is full of fragments of limestone, and is of excellent wheat-growing quality.

The Marcellus Shale (6), which overlies the Helderberg limestone, is thin, varying from a few feet in thickness to a maximum

* Those who are interested in the wheat-producing capabilities of the United States generally, and in their future relations to our own wheat markets, will find the subject discussed at some length in the 13th and 25th chapters of the author's '*Notes on North America.*'

of 60 or 80 feet. Its effects on the surface of the district therefore are chiefly to improve the soils of the limestone at the points of junction, and to form occasional narrow stripes and patches of stiff clay, richly calcareous, and productive in wheat. When the escarpment of the Helderberg limestone is less bold than where I visited it, near Syracuse, its surface is generally overspread with the débris of the softer rocks which adjoin it on either side. It is so in the line of the cross section N S (Section, No. III.), and there the soils which cover it form a prolongation of the rich land, fertile in wheat, which covers the plains below.

In the accompanying outline map it will be seen that the belt formed by these rocks (5 and 6) is very narrow in Western New York. Farther to the west however it expands, and along the north shore of Lake Erie it forms a wide and valuable tract of land in the fast filling-up and fertile region of Western Canada.

No. 7, *the Hamilton Group*, consists of olive and dark-blue shale, which, when alone, forms stiff dark-coloured clays far less rich in calcareous matter than the Onondaga soils. They are therefore less open and friable, and in consequence more difficult and expensive to work. Still they are capable of producing excellent wheat under favourable circumstances, or when properly prepared. The celebrated Genessee valley rests on this formation, but the natural soil of the Hamilton shales is there modified, or altogether covered by drifted fragments of the Niagara limestone and other more northern formations, which have been washed up the valley. Hence the quality of the Genessee soils is not that which is natural to those of the Hamilton group.

This group is of great thickness, and, as is shown in the map, forms a belt of land 10 or 12 miles in breadth. Where the shales are rich in lime they are submitted to arable culture. They are everywhere however difficult to keep clean, and are especially infested with corn gromwell (Lithospermum arvense), called here pigeon-weed. They are for the most part, therefore, like our own stiff clays of the lias and other formations, left to perpetual grass, which they produce of excellent quality. Here, therefore, the grazing and dairy country of Western New York commences.

Nos. 8 and 9. *The Genessee Slate* (No. 8), which is separately distinguished in the cross section (No. III.), is too thin to form an important agricultural feature of the country. It crumbles more slowly than the Hamilton shales; but where its fragments mix with those of the Tully and other thin limestones and calcareous shales beneath it—also represented in the section—it forms good soils.

The Portage and Chemung Groups (No. 9) consist of alternations of shales, poor in lime below, with flagstones and massive sandstones. They are of enormous thickness, and extend south-

wards beyond the borders of Pennsylvania, where in the line of section they reach a height of 1000 feet above Lake Ontario.* These rocks belong to the Devonian series of English geologists, and lie immediately under the old red sandstone, which begins to cover them beyond the Pennsylvanian border—further towards the south than the map or section extends.

The district occupied by these groups of rocks presents a complete contrast to the wheat-region—a contrast rich in evidence of the close relation between geological structure and agricultural capabilities. When first cleared the virgin surface produces crops of wheat, but after the first crops—as is the case in many parts of New Brunswick, which rest upon similar rocks—winter wheat becomes uncertain, and spring grain only can be sown. Being thus found naturally poorer, it is less cleared and cultivated than the more favoured land in the plains which border the lakes. Like poor land among ourselves also—I may say like poor land in all countries—it is occupied for the most part by a poorer race of cultivators, who direct their chief attention to the rearing of stock and to dairy husbandry.

The cross section, taken along the line N S in the map (p. 18), exhibits at a glance the relations—physical, geological, and agricultural—of this interesting district. It commences from Lake Ontario on the north, and is continued nearly to the Pennsylvanian border on the south.

The above section sufficiently explains itself. It exhibits in brief what in the preceding pages it has been necessary to state verbally a little more in detail. The points it is intended chiefly to illustrate are—

a. The physical and geographical position of this celebrated wheat-region in reference to Lake Ontario.

b. The special agricultural relations of the several groups of rocks which in this district form the Silurian system of English geologists.

c. The sudden and striking change of produce and capability which manifests itself when we ascend from the calcareous soils of the lower region, to the stiff clays of the more elevated Hamilton group of rocks. The wheat region, par excellence, is then entirely left behind, and a dairy country commences. And

d. The still further contrast presented by what in our island would be the heathy hills and moors of the Portage and Chemung groups—destined, like our own poorer hills and highlands, to rear the hardier breeds of stock.

On all these points I have already dwelt probably in sufficient detail.

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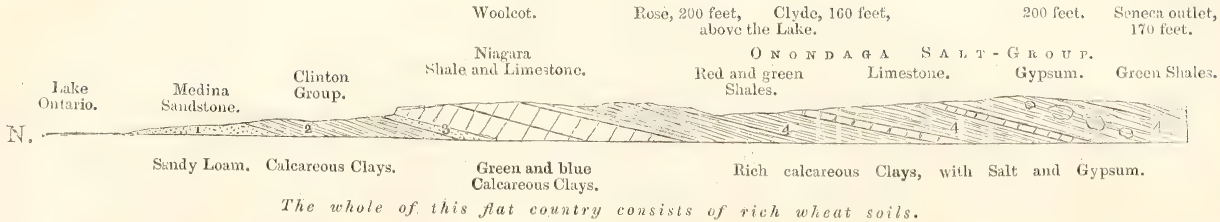
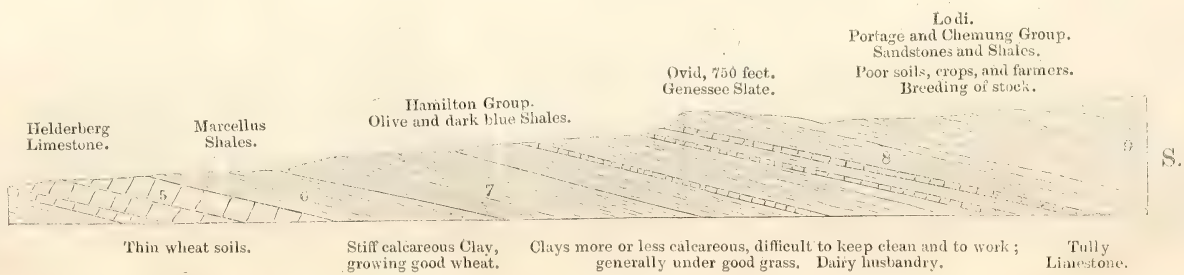
* Ontario itself is 231 feet above tide-level.

No. III.


Woolcot.
Rose, 200 feet, Clyde, 160 feet, above the Lake.
200 feet.
Seneca outlet, 170 feet.
Niagara Shale and Limestone.
Onondaga Salt-Group.
Red and green Shales.
Limestone.
Gypsum.
Green Shales.
Lake Ontario.
Medina Sandstone.
Clinton Group.
N.
Sandy Loam.
Calcareous Clays.
Green and blue Calcareous Clays.
Rich calcareous Clays, with Salt and Gypsum.
The whole of this flat country consists of rich wheat soils.


Lodi.
Portage and Chemung Group.
Sandstones and Shales.
Poor soils, crops, and farmers.
Breeding of stock.
Ovid, 750 feet.
Genessee Slate.
Hamilton Group.
Olive and dark blue Shales.
Helderberg Limestone.
Marcellus Shales.
S.
Thin wheat soils.
Stiff calcareous Clay, growing good wheat.
Clays more or less calcareous, difficult to keep clean and to work; generally under good grass. Dairy husbandry.
Tully Limestone.

There are two additional observations however which I will venture to introduce as likely to interest the general reader. They are both in substance somewhat scientific, yet both entirely practical in their bearing.

First. In speaking of the soils which rest upon the Marcellus shales represented in the above section, I have alluded to the difficulty experienced in keeping them clean, and to their being especially infested with the corn gromwell (Lithospermum arvense), known in North America by the various names of pigeon-weed, red-root, steen-crout, stony-seed, and wheat-thief. In Yates County, in Western New York, a little to the west of the line of section N S, the pigeon-weed is described to be so abundant in some places as almost to have become the lord of the soil. It was unknown there—as it is said to have been in all this lake country, and on the river flats of the St. Lawrence—thirty years ago. It is supposed to have been an importation from Europe, probably in samples of unclean seed-corn from England, France, or Germany. Now "hundreds of bushels of the seed are purchased at the Yates County oil-mill, and, if it were worth 8*s.* instead of 1*s.* 6*d.* a bushel, these hundreds would be thousands."*

My readers will observe in the concluding words of this quotation how one evil leads to another. The purchase of this seed at the oil-mills must be mainly for the purpose of adulteration.† I have examined samples of American linseed cake, in which seeds were to be recognised that I could not name. They might, I then thought, be those of the dodder—a parasite which in this country infests the flax-plant in some localities—but they might also be other cheap seeds purposely mixed with the linseed. To persons who are in the habit of buying the cheaper varieties of American cake this point may not be unworthy of attention; and as oil-cakes are chiefly bought by farmers, some may regard it as a kind of poetical justice, that the idle farmers in one country should be the means of punishing the less discerning of their own class in another.

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* Transactions of the New York State Agricultural Society, 1846, p. 436.

† In the Transactions of the New York State Agricultural Society for 1850, p. 512, I find it stated that this seed yields two or three quarts of oil from a bushel of seed. As a gallon of such oil weighs about 7½ lbs., we may take *four pounds* as the average yield of this seed per bushel. But linseed of 52 lbs. a bushel yields 17 lbs. of oil; and the best rape of 56 lbs. yields 16 lbs. a bushel. Supposing the gromwell seed to be about 50 lbs. weight per bushel, 4 lbs. of oil would barely pay the cost of expressing, were it not for the value of the cake. English crushers reckon that, for an additional shilling in the price of linseed per quarter, about 3 lbs. more of oil should be yielded, so that in their reckoning, 1*s.* 6*d.*, the price of the gromwell seed, would require 4½ lbs. of oil to pay the cost of the seed alone. The value of the cake therefore, as I have said in the text, must be what the Yates County crushers mainly look to.

The physiological history of this Lithospermum teaches us both how necessary a certain amount of physiological knowledge, in reference especially to the plants of his own local flora, is to the practical farmer; and also how unexpectedly the careless farmer may be punished for a neglect of what may be called the very first rule of strong-land farming—that is, of keeping his land clean. On the flat clay lands of Lower Canada, opposite to Montreal, formerly celebrated for their wheat, I found the same weed spoken of as a universal pest, though as in New York State it was said to have been wholly unknown thirty years before. A constant repetition of wheat crops for a long series of years without cleaning had led to this result.

The peculiarities in the character and habit of this weed consist, *first*, in the hard shell with which its seed or nut is covered; *second*, in the time at which it comes up and ripens its seed; *third*, in the superficial way in which its roots spread. The hardness of its covering is such that "neither the gizzard of a fowl nor the stomach of an ox can destroy it." Thus it will be for years in the ground without perishing—ready to sprout when an opportunity of germinating occurs. It grows very little in spring, but it shoots up and ripens in autumn, and its roots spread through the surface soil only, and exhaust the food by which the young wheat should be nourished. A knowledge of these facts teaches us, *first*, that unless care be taken to exclude the seed from the farm it will remain a troublesome weed for many years, even to the industrious, careful, and intelligent cultivator. It is said to be so prolific as to increase "more than 200 fold annually!" In the *second* place, that spring ploughing will do little good in the way of extirpating it, as at that season it has scarcely begun to grow. United spring and autumn ploughing is "the only reliable remedy." *Thirdly*—that raising wheat year after year allows it to grow and ripen with the wheat, and to seed the ground more thickly every successive crop. It is said that when it has once got into the land two or three successive crops of wheat will give it entire possession of the soil. It is not therefore the immediately exhausting effects of successive corn crops which have alone almost banished the wheat culture from large tracts of land in North America, especially on the river St. Lawrence; the indirect or attendant consequences of this mode of culture—the weeds it fosters, &c.—have had an important influence also.

These observations are not without their value at home. For although with us a continued succession of corn crops is rarely now seen upon any land, yet foul and weedy farms are unhappily still too frequent. And the more one studies the history and habits of the weeds, which almost every district can boast of as

peculiarly attached to itself, the more one becomes satisfied of the value of a familiar acquaintance with them, to the improvement of the art of culture, of the condition of those who practise it, and of the agricultural productiveness of a country. No one will readily accuse me of a desire to undervalue the usefulness of chemistry to agriculture, and yet I have often had occasion to regret the evil influence of opinions hastily expressed by ill-informed persons—as if this branch of knowledge alone were able to bring this most important and difficult of arts to speedy perfection. The longer a cautious and truth-seeking man lives, the wider will appear the range of knowledge, theoretical and practical—the more numerous the circumstances to be taken into consideration—before he can arrive at an accurate solution even of what some look upon as simple and superficial questions.

Second. The second observation I wish to add refers to the extension of the richest wheat-bearing formations of Western New York into the upper part of Canada West. The consequence of this extension is the reproduction in this new region of the great natural capabilities of the country I have been describing.

Bounded on the east by Lake Ontario, on the west by Lake Huron, on the south by Lake Erie, and on the north by Manatoulin Bay, stretches a wide peninsula, occupying an area three or four times as large as the wheat region of Western New York, and covered entirely by those rocky formations on which the fertility of the latter region mainly depends. Proceeding westward from the head of Lake Ontario, we pass in succession over the surface of the Medina sandstone, the Niagara limestone, the Onondaga salt group, and the Helderberg limestone and shales. On these, as the map and sections contained in this paper show, the principal wheat region in Western New York is situated. It will also be recollected that among these the Onondaga salt group is especially conspicuous for the natural fertility and friableness of its soils, and for the ease with which they can be worked and cultivated.

Now in this peninsular portion of Canada West, the Medina sandstone and Niagara limestone expand a little after they turn round the western end of Lake Ontario, and then run towards the north in belts somewhat broader than those which they form in Western New York. But the Onondaga salt group widens to such a degree as in a line due west from Toronto to be upwards of sixty miles across, and to occupy almost the whole breadth of the peninsula between the two lakes, Ontario and Huron. The natural capabilities of this new region, as a whole, may be inferred from what I have already said of the results of experience in the state of New York. So far as depends upon soil, it ought to be one of the richest agricultural regions in North America.

Towards the southern end of the peninsula again, and along the entire northern margin of Lake Erie, of the Lake and River St. Clair, and of Gratiot's Bay, in the southern part of Lake Huron, the Helderberg formation extends. It will be recollected that I have above described this rock, as it occurs in Western New York, to be in some places covered with thin soils productive of wheat; but that over it lie certain calcareous shales (Marcellus shales), which, when not entirely removed from the surface by the action of ancient waters, form a soil equal to almost any other in productive capability. The large portion of this Western Canadian peninsula, over which this Helderberg formation extends, must, therefore, like that occupied by the Onondaga group, contain many tracts of fertile land, and this, as well as its neighbourhood to the lake, is no doubt a cause of the rapidity with which it is in the process of settlement. Indeed, when we consider that nearly the whole of this peninsular region consists either of the Helderberg rocks or of those of the Onondaga group, we cannot help predicting both a rapid filling up and a great future, in many respects, to this most interesting portion of Canada.

Thus from the humbler task of explaining why certain regions have exhibited and still manifest a singular natural fertility, geology advances to the higher gift of prediction. United theory and observation enable it to point out where rich and desirable lands are sure to be found—to inform the statesman as to the true value of regions still wild and neglected—to direct the agricultural emigrant in the choice of new homes—and, looking far into the future, to specify the kind of population and the processes of industry which will hereafter prevail upon it — the comparative comfort, wealth, numbers, and even morality, of its future people.

A third illustration, not less interesting than the two already introduced, I had intended to draw from our own province of New Brunswick, but this I must reserve, with the remainder of my subject, for another article.

II.—*On the Production of Butter.* By Thomas Rowlandson, C.E., F.G.S.

Prize Essay.

Milk—the fluid secreted by females of the class mammalia, for the nourishment of their young—is a white, translucent, aqueous emulsion, the principal components of which are the oily compounds called butter, casein or curd, a species of sugar, and certain salts.

Under the microscope milk appears as a transparent fluid, in which small white globules are diffused, of variable diameters, in the same milk, as well as in that of different animals. These globules collect upon the surface of the milk, when allowed to remain at rest, or *stand*, forming the substance known as cream. Some have supposed these to be naked globules of fatty matter, others consider that they are surrounded by a distinct containing membrane. The latter view is, in some degree, rendered probable from the circumstance that they do not coalesce by standing, or when gently heated, nor does ether directly dissolve them; but when acetic acid is added to milk, it appears to dissolve the containing caseous or albuminous membrane, and the globules then coalesce into drops, which ether readily takes up.

The specific gravity of milk varies; that of the cow is generally about 1·030. As it is affected by the presence of butter on the one hand, which diminishes, and the casein and salts on the other, which increase its density, it is difficult to ascertain a mean, or to form an estimate of its value by this means; all lactometers are consequently fallible as indicators of the value of milk.

According to Berzelius, the specific gravity of skimmed milk is 1·033, that of cream 1·024, consisting as follows:—

Skimmed Milk.

Water	928·75
Caseous matter, or curd, with a trace of butter	28·00
Sugar of milk	35·00
Hydrochlorate and phosphate of potash	1·95
Lactic acid, acetate of potash, and a trace of lactate of iron	6·00
Earthy phosphates	0·30
	1000·00

Cream.

Butter	4·5
Curd	3·5
Whey	92·0
	100·0

Haidler obtained from 100 parts of cow's milk

Butter	3·0
Sugar of milk, and soluble salts	4·6
Casein, and insoluble salts	5·1
	12·7

and from 100 parts of milk, the produce of two cows, he procured the following salts:—

Phosphate of lime	0·231	0·344
Phosphate of magnesia	0·042	0·064
Phosphate of iron	0·007	0·007
Chloride of potassium	0·144	0·183
Chloride of sodium	0·024	0·034
Soda	0·042	0·045
	0·490	0·677

As respects quantity and quality of milk, there exists a wide range, not only with regard to the yield from cows of different breeds, but also from cows of the same breed; the subject is still further complicated, owing to diversities either in the quality or quantity, or in both, caused by feeding on different varieties of food; which are again liable to variation with respect to the period of gestation at which the milk has been collected. Rapid changes in its character occur preceding and immediately after parturition.

Lessaign examined milk at ten different periods, four before and six after parturition. The milk examined during the first three of the former periods, namely, 42, 32, and 21 days before parturition, contained no casein, but in place of it albumen; no sugar of milk and no lactic acid, but a sensible quantity of uncombined soda. That examined eleven days before and just after parturition, contained both albumen and casein; while milk, eleven days before, and shortly after it, contained free lactic acid and sugar of milk, but no free soda. The milks examined 4, 6, 20, 21, and 30 days after parturition, contained casein and no albumen.

A valuable series of experiments was instituted by Dr. Playfair, for the purpose of ascertaining "the changes in composition of the milk of a cow, according to its exercise and food;" they are published in the first volume of the 'Transactions of the Chemical Society of London,' in the course of which the author expresses a regret, which all agriculturists must participate in, "that the value of the experiments is diminished by not being extended over a series of days on each kind of food." "But in England," the author adds, "where the price of ether is so exorbitantly high, the expense of such experiments is a serious

consideration for a private individual." As these experiments are of the utmost importance, as guides to a sound conclusion respecting the subject under investigation, the following extracts are subjoined :—

The cow which was the subject of experiment was of the short-horn breed, and the period that had elapsed since calving unknown. When the experiments were instituted she was in good milking condition. In order to estimate the average amount of milk, it was measured several days previous to the experiments, during which time she subsisted upon after-grass, the meadow being about half a mile distant from the cow-house.

	Evening's Milk. Quarts.	Morning's Milk. Quarts.
October 5	5	4½
„ 6	5	5
„ 7	4½	5
„ 8	5	4
„ 9	5¼	4

The weather was fine for the period of the year, but the nights being rather cold, directions were given that the cow should be driven to the house, and remain there during the night. In the morning she was put out to grass, but brought back in the evening. On the evening of the 9th the analyses were commenced, and were followed up for successive days. In every case the specimen of milk analysed was taken from the milk pail after the cow had been thoroughly milked, and the milk well stirred.

1st day. The cow fed in the meadow upon after-grass during the day, was driven home to the cow-house in the evening; the milk then obtained amounted to four quarts; specific gravity, 1·034.

11·128 grammes* of milk gave—

		In 100 parts.
Casein	·611	5·4
Butter	·404	3·7
Sugar of milk	·429	3·8
Ashes	·068	0·6
Water	9·616	86·5
	11·128	100·0

The animal received nothing to eat during the night, consequently the milk of the morning must have been derived from the previous day's food. The milk measured four and a half quarts; specific gravity, 1·032.

15·280 grammes yielded—

		In 100 parts.
Casein	·610	3·9
Butter	·864	5·6
Sugar	·468	3·0
Ashes	·091	0·5
Water	13·247	87·0
	15·280	100·0

2nd day. The object of this day's experiment was to discover whether an increase of butter would be procured by feeding the cow with after-grass in the stall. It refused, however, to eat this food, and being removed from its com-

* A gramme equals 15·434 English grains.

panions, struggled for several hours to regain its liberty; to render it tranquil, a companion was introduced to the same stall, and it was then induced to consume 28 lbs. of good hay, and $2\frac{1}{2}$ lbs. of oatmeal. The milk of the evening measured $3\frac{1}{2}$ quarts; specific gravity, 1·031.

22·684 grammes yielded—

		In 100 parts.
Casein	1·124	4·9
Butter	1·150	5·1
Sugar	0·867	3·8
Ashes	0·137	0·5
Water	19·406	85·7
	22·684	100·0

The morning's milk amounted to 4 quarts, but owing to an accident was not analysed.

3rd day. A. The cow was kept in the shed, and consumed 28 lbs. of hay, $2\frac{1}{2}$ lbs. of oatmeal, and 8 lbs. of bean flour. The evening's milk amounted to 4 quarts = 10·34 lbs.; specific gravity, 1·034.

23·160 grammes gave—

		In 100 parts.
Casein	1·262	5·4
Butter	0·905	3·9
Sugar	1·112	4·8
Ashes	0·136	0·5
Water	19·745	85·4
	23·160	100·0

B. The quantity of milk obtained in the morning amounted to $4\frac{1}{2}$ quarts = 11·61 lbs.; specific gravity, 1·032.

19·445 grammes gave—

		In 100 parts.
Casein	0·758	3·9
Butter	0·888	4·6
Sugar	0·877	4·5
Ashes	0·129	0·7
Water	16·793	86·3
	19·445	100·0

4th day. A. The cow kept in the stall as before, received this day 24 lbs. of potatoes (steamed), 14 lbs. of hay, and 8 lbs. of bean flour; she gave in the evening 5 quarts of milk = 112·9 lbs.; specific gravity, 1·033.

17·820 grammes gave—

		In 100 parts.
Casein	0·707	3·9
Butter	1·190	6·7
Sugar	0·815	4·6
Ashes	0·104	0·6
Water	15·004	84·2
	17·820	100·0

B. The morning's milk amounted to 4 quarts=60·32 lbs.; specific gravity, 1·032.

19·641 grammes yielded—

		In 100 parts.
Casein	0·535	2·7
Butter	0·978	4·9
Sugar	0·991	5·0
Ashes	0·116	0·5
Water	17·021	86·9
	19·641	100·0

5th day. A. The cow kept as before, consumed 14 lbs. of hay, and 30 lbs. of potatoes (steamed), she gave in the evening $5\frac{1}{8}$ quarts of milk=13·18 lbs.; specific gravity, 1·030.

18·141 grammes yielded—

		In 100 parts.
Casein	0·716	3·9
Butter	0·845	4·6
Sugar	0·713	3·9
Ashes	0·099	0·5
Water	15·768	87·1
	18·141	100·0

B. The morning's milk amounted to $4\frac{3}{4}$ quarts=12·20 lbs.; specific gravity, 1·030.

16·740 grammes yielded—

		In 100 parts.
Casein	0·600	3·5
Butter	0·835	4·9
Sugar	0·648	3·8
Ashes	0·082	0·5
Water	14·575	87·3
	16·740	100·0

Dumas, in an announcement to the French Academy, advanced the theory that the fat of animals is wholly derived from the fatty matter contained in their food. As the theory of the formation of fat is of the first importance in dairy-farming, Dr. Playfair makes the following just observations with reference to the preceding experiments:—

1. On the second day the cow received 28 lbs. of hay, which contained 0·46 lbs. of fat, and $2\frac{1}{2}$ lbs. of oatmeal, containing 0·050 lbs. of the same constituent. The cow produced (calculating according to its specific gravity) about 19 lbs. of milk, in which were 0·969 lbs. of butter. But the food altogether contained only 0·486 lbs. of fat, so that 0·483 lbs. of butter must have been produced from other sources.

2. The food received by the cow on the 3rd day consisted of 28 lbs. of hay, $2\frac{1}{2}$ lbs. of oatmeal, and 8 lbs. of bean-flour.

28 lbs. of hay	contain	. . .	0·436 lbs. of fat.
$2\frac{1}{2}$,, oatmeal	,,	. . .	0·050 ,,
8 ,, beans	,,	. . .	0·056 ,,
		In the food	0·542

The milk of the evening amounted to 10·34 lbs., and contained 0·4 lbs. of butter; that of the morning to 11·61 lbs., and contained 0·5 lbs. of butter; the whole amounting to 0·9 lbs., of which only 0·542 lbs. could possibly have been furnished by the food, assuming that the fat in the food could only be converted into butter.

3. The cow received on the 4th day 14 lbs. of hay, 8 lbs. of beans, and 24 lbs. of potatoes.

14 lbs. of hay	contain	. . .	0·218 lbs. of fat.
8 ,, beans	,,	. . .	0·056 ,,
24 ,, potatoes	,,	. . .	0·072 ,,
		In the food	0·346

The evening's milk amounted to 12·9 lbs., and contained 0·86 lbs. of butter; that of the morning to 10·32 lbs., and contained 0·50 lbs. The cow, therefore, furnished during the day 1·36 lbs. of butter. The fat in the food only amounted to 0·346 lbs., therefore 1·064 lbs. must have been obtained from other sources.

4. On the 5th day the cow received 14 lbs. of hay, and 30 lbs. of potatoes.

14 lbs. of hay	contain	. . .	0·218 lbs. of fat.
30 ,, potatoes	,,	. . .	0·090 ,,
		In the food	0·308

The milk of the evening amounted to 13·18 lbs., and contained 0·606 lbs. of butter: that of the morning to 12·20 lbs., containing 0·597 lbs. of butter. The cow, therefore, furnished 1·203 lbs. of butter. The fat in the food amounted only to 0·308 lbs.; hence 0·895 lbs. of butter must have been produced from other sources.

From the preceding calculations it is presumed that the excess of butter, beyond that contained in the food, has been produced by a separation of oxygen from the elements of the unazotised ingredients of the food, such as starch and sugar, in the manner pointed out by Liebig.

In the preceding experiments there are several variations; this will ever be found the case where so much depends upon the health and disposition of the animal, over which man can possess little, if any control; many circumstances may pass unheeded by the observer, which may powerfully influence the character of the milk. It will be seen that in the milk of the first day there is a small amount of butter. The cow had been exposed in the field during the day, and hence required a greater quantity of unazotised food to support the heat of her body than would have been necessary had she been protected from the cold; but in the

evening she was removed into a warm, well littered stall, where the warmth thus communicated was equivalent to a certain amount of food: hence we find that the milk of the morning was considerably richer in butter. Besides the warmth of the shed, less butter is consumed by the oxygen of the air. In the stall, the respirations of an animal are much less frequent than in the field, and consequently less oxygen enters into its system. Hence it is a practice to milk those cows in the field that are distant from home, and to drive home to be milked only such cows as are close to the shed. The exercise required in walking home causes an increased play of the respiratory system, and therefore increases the amount of oxygen inhaled. This oxygen unites with part of the butter and consumes it; all good dairymen allow the cows to walk home at their own pace, and never accelerate it. When a cow is harassed, and runs to escape from the annoyance, her milk becomes very much heated, diminishes in volume and in richness, and speedily becomes sour. This is a fact well known to all dairymen. During running, the cow inhales a large quantity of oxygen; this unites with the butter, the heat evolved by its combustion elevates the temperature of the milk, and acetous fermentation being induced, the milk thus becomes sensibly sour.

The view here taken of the production of butter, from the amylaceous and other unazotised portions of the food, is supported by the increased amount of butter yielded, after being partially fed upon potatoes. The quantity of casein in the milk appears also to be intimately connected with the nature of the food, being more abundant when supplied with bean and oatmeal; and would justify the conclusion that within certain limits the quality of milk may be made to vary in its composition, by regulating the food of the animal.

As the preceding experiments may be looked upon as being on too limited a scale to draw a just general conclusion, I will here insert what was pointed out to me as a remarkable instance in practical dairy management, in the county of Chester, which is strongly confirmatory of the previous views:—

It has been remarked in Cheshire, and I believe in other extensive cheese districts, that it is impossible to make cheese of the first quality from milk obtained from cows fed upon tares and clover; notwithstanding which, I had pointed out to me a farm where the whole of the cows were fed, almost exclusively during the summer, on tares and clover, the entire produce of which dairy was converted into cheese, and that of a quality so excellent, that it always obtained the highest price from the London dealers at the Chester cheese fairs. The circumstance was related to me as an illustration of what could be accomplished

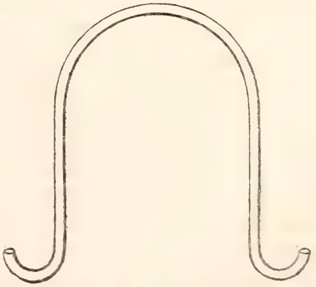
by management,—the dairywoman being esteemed one of the best hands in that celebrated cheese making county. My own conclusions were, that mere manipulation had little to do with it. The best cheese is a compound of cheese and butter. When the cattle were fed *at large* on leguminous food, rich in casein, that substance greatly preponderated in the milk, the butter being partially consumed by the animal in the course of the exercise requisite to procure its food, &c.; when fed *in the house* with the like food, the butter was necessarily yielded in greater proportion, consequently formed a rich fat cheese. In concluding these observations on milk, it must be remarked, that the milk obtained from different breeds varies greatly with respect to the quantity of butter which it contains, and still more with respect to the milk drawn from the cow at the commencement, and near the conclusion of the milking, the latter being provincially termed "strippings," and "afterings." Schubler says that the milk last drawn contains three times as much cream as the first. Dr. Anderson found the cream in the last cup of milk drawn from the udder, compared with that of the first cup, in the proportion of 16 to 1; it is consequently of the greatest importance that the cow should be milked perfectly "dry at each meal." For another reason this ought to be carefully attended to: when the larger vessels are regularly emptied, milk is being constantly secreted by the capillary milk vessels; when, however, from any cause the whole are allowed to become gorged for a lengthened period, this secretion ceases, and absorption of the thinner, or watery portion, commences. It may easily be conceived that this absorption takes place more readily in the smaller and more distant tubes, than in the larger and more external vessels. If this full state of the vessels continues any length of time, the secretion of milk will cease or diminish, not unfrequently attended by serious inflammation; materially impairing, or altogether destroying, the function of the milk gland.

In milking, the cow should be milked "*clean*" at once; some are in the habit of doing this at twice or thrice. The cow is a sensitive and capricious creature, easily offended; and if the dairymaid rise from her before the milk is all withdrawn, the chances are that she will not stand quietly, with the further probability that she will *hold back* her milk the second time. Where there are more than one dairymaid, each should have a particular set of cows apportioned to her, cows preferring to be milked by a constant acquaintance rather than by a stranger. During the flush of grass, when the cows are loaded with milk, it may be well always to go round a second time, by which means frequently a teacupful to half a pint of milk can be obtained.

Milking should be done *fast*, to draw off the milk as quickly

as possible. From the period of drawing the first milk from the heifer, to the time she is intended "to be put up" for the butcher, gentleness and kindness should be exercised towards her. No doubt some cows are very capricious and troublesome—such ought to be sold, or sent to the slaughterhouse as soon as possible; if a cow cannot be managed with kindness, thumps and kicks will be found of no avail. Some cows yield their milk with a copious flow on the gentlest handling, others require great exertions. The udder of the former will have a soft skin, with short teats; that of the latter will possess a thick skin, with long and tough teats. Before leaving this part of the subject it may be mentioned, that in some parts of Switzerland and France it is a not uncommon practice to spay milch cows whilst in a full flow of milk, a short time after calving, by which means they continue in milk some years.

It is almost unnecessary to remark that every utensil connected with the dairy ought to be kept perfectly clean and sweet, being well scalded, and subsequently washed out with clean cold water. The milk, being drawn from the cow, should be put into a vessel to cool—a clean tinned vessel is the best for this purpose; it ought not to stand so long, or be allowed to cool so much, as to permit the cream to partially separate; being cooled, it should be strained through a hair sieve into the milk dishes (glass ones are the best). The depth of milk should not exceed four inches; it is stated that two inches is the most profitable mode. In a dairy maintained at a proper temperature, the cream should be gathered every 24 hours; but in very hot weather the milk ought not to stand more than 18 hours, at the utmost. The common mode of procuring cream is by a skimmer; others have constructed vessels by which the blue or skim milk is allowed to flow through an orifice in the bottom of the vessel. Recently it has been proposed to use a syphon for this purpose; the ordinary syphon is, however, very troublesome. If syphons ever come into general use, they ought to be formed of the annexed figure. When constructed with a curved terminal to each leg, the syphon may be carried about, or hung up ready for use at any moment, it being only requisite, in using it, to maintain the leg placed in the milk at a slight degree of elevation above the outer leg. Syphons of this kind have been long in use in acid manufactories.



The processes used for making butter in different districts are much more numerous than is generally imagined; a similar remark

applies to the churns used ; the varieties of the latter have greatly increased of late years. For the present, I shall confine my remarks to the mode of using the milk, cream, &c., and the proper temperature of churning. The form of the churn will receive subsequent attention.

Some very elaborate experiments on butter-making were undertaken by Professor Traill and the late Dr. Gerard, assisted by the late Dr. Bostock ; they were published in the "Highland Transactions." The writer of this paper was made acquainted with many of these results by one of the experimenters, now deceased, and subsequently tested them on a working scale. Owing to removals, and the lapse of time, the notes are lost or mislaid ; he, however, distinctly recollects that in all instances but one the products, on an ordinary routine, agreed remarkably with those made by the gentlemen alluded to.

One series consisted of "*The comparative quantity of Butter yielded* by

1. Sweet cream churned alone.
2. Sweet milk and its cream churned together.
3. Sour cream churned alone.
4. Sour milk and its cream churned together.
5. Scalded or Devonshire cream churned alone.

On the 24th of May, 1807, the milk of four cows was drawn in the same vessel, passed through a strainer, and then divided into five portions of six English pints each, which were placed in similar basins of earthenware, in a place, the temperature of which ranged from 55° to 60° Fahr.

Monday, 25th.—The temperature of the air was very hot, 76° ; but that of the milk-house, by constant evaporation of water, was kept about 60°.

Tuesday, 26th.—Thirty-nine hours after the milk had been drawn from the cows it was removed from below the cream of No. 1 and No. 3 by a syphon; the cream from No. 1, and the milk and cream from No. 2, were immediately churned in glass vessels.

No. 1.—Sweet cream churned alone. From previous trials it was found that the addition of cold water to thick cream facilitated the separation of the butter ; half a pint of water was added to the cream, the temperature of the mixture at the commencement of churning was 62°. In 15 minutes butter appeared in grains ; the churning was continued for 12 minutes longer, or 27 minutes in all, when the temperature was found at 70°. The butter was collected, but from the warmth of the weather was very soft. It was put into cold water until the next day, when it was worked and washed in the usual way, and weighed 1386 grains. It was of a good colour, and perfectly well flavoured.

No. 2.—Sweet milk and its cream churned together. The mixture of sweet milk and cream was churned at the same time; though cold water was added after one and a half hours' churning, no butter was seen. The churning was continued three hours without obtaining butter.

No. 3.—Sour cream churned alone. On Thursday, the 28th May, the cream of No. 3, which had been separated on Tuesday, and placed in the milk-house, was now slightly acid, and was churned after half a pint of cold water had been added to it. In twelve minutes butter appeared; and in eight minutes more had united into one mass. During the churning the temperature of the cream had risen from 54° to 63°. The butter, when well washed and worked, weighed 1756·5 grains; the colour and taste were very good.

No. 4.—Sour milk and its cream churned together. On the same day, 28th May, the milk and cream which had become acid were churned together, and half a pint of cold water was added. It was full fifty-seven minutes before any butter appeared, and before the churning appeared to be completed one hour and fifty minutes had elapsed; showing clearly that more time is required to churn milk and cream together than to obtain the butter from cream alone. The butter was diffused in small grains, and when washed and worked as long as any colour was communicated to the water, it weighed 1968 grains; colour paler than the last, but of good flavour.

No. 5.—Clouted cream churned alone. On Tuesday, the 26th, the milk and cream of No. 5 were placed in a vessel of warm water until the temperature of the milk rose to 156°, a Devonshire dairymaid assisting in the operation. The milk was drawn from below the cream by a syphon, the latter being kept cool until the following day, when it was churned.

It was ascertained that by churning the milk of Nos. 1 and 3, a few more grains of butter could be obtained on some occasions, but on no occasion from No. 5, so completely does the scalding process separate the butyraceous matter from the milk. The butter of No. 5, when well worked and washed, weighed 1998 grains. It had a rich yellow colour, and tasted agreeably.

Similar experiments were repeated, the result of which was, that the largest amount of butter was produced by the Devonshire method; the next in quantity, by churning the milk and cream together when a little acescent; the third in quantity was afforded by cream kept till it was slightly sour. The smallest quantity was obtained from sweet cream; but on no occasion was butter obtained by churning sweet milk alone.

In order to decide on the keeping qualities of the butter obtained by the four processes previously detailed, samples were

exposed to the free action of the atmosphere. No. 1 was always found to remain longer without any rancid taste than the other kinds; No. 3 and No. 4 were nearly on an equality—if any difference, it was in favour of No. 3; No. 5 became rancid more quickly than No. 3 and No. 4. When salted for keeping, rancidity appeared in about the same order, commencing in No. 5, or the butter from scalded cream; next in No. 4, from some milk and cream; then in No. 3, or sour cream; and lastly, in No. 1, obtained from sweet cream. The rancidity was supposed to arise from varying proportions of casein; and on instituting experiments to ascertain this fact, it was found that casein existed in lesser proportion according to the power of the butter in preserving its freshness.

In order to ascertain the effects of overchurning, the cream of six pints of milk was separated by a syphon, and churned in a glass vessel. The butter was formed in about half an hour; but the churning was continued for half an hour longer, when the butter had lost its fine, yellowish, waxy appearance, and had become pale and soft, while very little liquid remained in the churn. This butter could not be washed and worked until it had remained some hours in cold water, being so exceedingly soft when taken out of the churn. After washing, it was pale, rather soft, and weighed 2566 grains, which was evidently beyond the due quantity, when compared with the other experiments on the same quantity of milk, which gave the following results:—

No. 1.	The sweet cream overchurned	yielded	2566	grains.
,, 3.	The acid cream duly churned	,,	2187·5	,,
,, 4.	The acid milk and its cream duly churned .	,,	2397·5	,,
,, 5.	Scalded cream duly churned	,,	2671	,,

The butter of No. 1 tasted insipid, never became firm, and soon turned rancid. It was found to yield a very unusual quantity both of casein and watery fluid, which could only be separated by melting the butter.

It is a common opinion in some districts, that by adding hot water to the churn, more butter is obtained than by using cold water. Experiments made for the express purpose did not show that the weight increased very much, and it was attended with a perceptible deterioration in quantity, giving it generally the appearance of overchurning.

The results of the experiments above detailed are,—

1st, That the addition of some cold water, during churning, facilitates the process, or the separation of the butter, especially when the cream is thick and the weather hot.

2nd, That cream alone is more easily churned than a mixture of cream and milk.

3rd, That butter produced from sweet cream has the finest flavour when fresh, and appears to remain the longest period without becoming rancid.

4th, That scalded cream, or the Devonshire method, yields the largest quantity of butter; but if intended to be salted is most liable to acquire a rancid flavour by keeping.

5th, That churning the milk and cream together, after they have become slightly acid, is the most economical process for districts where butter-milk can be sold; whilst at the same time it yields a large amount of excellent butter.

The preceding experiments are instructive as showing the most judicious form in which milk and its products ought to exist previous to churning. They are, however, defective in one important particular, viz., the effect of temperature on churning; for this I must refer to the experiments of Dr. John Barclay and Mr. Alexander Allen, commenced on the 18th August, 1823:—

1st Experiment.—Fifteen gallons of cream were put into the churn at the temperature of 50°, the weight per gallon having been previously ascertained to be 8 lbs. 4 ozs. By agitating the cream in the usual manner for the space of two hours, the temperature rose to 56°; at the end of the churning, being four hours from the commencement of the operation, the temperature was found to be 60°, or 10° higher than at the commencement. The quantity of butter obtained in this process was 29½ lbs. avoirdupois, or nearly 2 lbs. of butter for each gallon of cream put into the churn. The butter was of the best quality.

2nd Experiment, 26th August, 1823.—Fifteen gallons of cream were put into the churn at the temperature of 55°, the weight per gallon being 8 lbs. 2 ozs. By agitating the cream, as formerly, for one hour and a half, the temperature rose to 60°; at the end of churning, being three hours and fifteen minutes from the commencement of the operation, the temperature was ascertained to have increased to 65°, or 10° higher than at the commencement. The yield of butter was 29 lbs. 4 ozs., of good quality, not sensibly inferior to that obtained in the former experiment.

3rd Experiment, 29th August, 1823.—Fifteen gallons of cream were put into the churn at a temperature of 58°, the weight per gallon being 8 lbs. 2ozs. At the end of an hour's churning the temperature had risen to 63°, and at the end of the process, which lasted three hours, the temperature was found to be 67°, or 9° higher than at the commencement. The quantity of butter obtained was 28 lbs., and was slightly inferior in quality to the butter produced in the two previous experiments.

4th Experiment, 4th September, 1823.—The same quantity of cream was employed as in the former experiments, the temperature being 60°, and the weight per gallon 8 lbs. 1 oz. During

the process the temperature increased as formerly, and at the end of three hours, when the operation was finished, it was ascertained to have risen to 68°. The quantity of butter obtained was 27 lbs., of a quality similar to that obtained in the last recited experiment.

5th Experiment, 9th September, 1823.—A like quantity of cream was used at the temperature of 66°, and the weight per gallon 8 lbs. The churning occupied two hours and a half, at the expiration of which the temperature was found to have risen to 75°, being an increase of 9°. 25 lbs. 8 ozs. of butter were obtained by this experiment, of a character much inferior to that produced in any of the former experiments, being soft and spongy.

The results are, for conciseness, shown in the following table:—

No.	Date of Experiments.	No. of gallons.	Mean temperature.	Time occupied in churning.	Quantity of butter obtained per gallon.	Weight of the churned milk per gallon.
	1823.		°	h. m.	lb. ozs. dwts.	lbs. ozs.
1	Aug. 18	15	55	4 0	1 15 7·5	8 9
2	„ 26	15	60	3 15	1 15 3·2	8 8
3	„ 30	15	62	3 0	1 14 0	8 8
4	Sept. 4	15	64	3 1	1 12 12·7	8 8
5	„ 9	15	70	2 30	1 10 10·6	8 7

About the same period a similar set of experiments on churning cream was made by Mr. John Ballantine, of Edinburgh, from which it appeared that the greatest quantity of butter from a given quantity of cream is obtained at 60°; and the best quality at 55° in the churn just before the butter comes. When the heat exceeded 65°, no washing could detach the milk from the butter without the aid of salt; but when a quantity of salt was wrought well into it, and the mass allowed to stand for 24 hours, subsequently being well washed with cold spring water, the serous portion of the milk was extracted.

No.	Date.	Scotch Pint of Cream.	Degree of heat in the cream.	Degree of heat when the butter comes.	Quantity of butter, 16 ozs. to the lb.	Time of churning.	Weight of cream of 16 ozs.	Heat of the air at 8 P.M.
	1825.		°	°	lbs. ozs.			°
1	Jun. 13	16	56	60	16 8	$1\frac{1}{2}$ hours.	4 lbs. to pint	56
2	„ 20	16	52	56	16 0	2 hours.	ditto	52
3	„ 24	16	52	56	16 0	2 hours.	ditto	52
4	July 12	16	65	67	15 8	30 minutes.	3 lbs. 14 ozs. do.	70
5	Oct. 20	16	50	$53\frac{1}{2}$	15 12	3 hours.	4 lbs. 1 oz. ditto.	50
6	Aug. 20	16	$53\frac{1}{2}$	$57\frac{1}{2}$	16 5	$1\frac{1}{4}$ hours.	4 lbs. ditto.	

No. 1 shows the greatest quantity of butter produced.
,, 2 shows the best quality.
,, 3 excellent.
,, 4 soft, white, and milky.
,, 5 injured by long churning.
,, 6 excellent.

The same gentleman, after an experience of thirty years, came to the conclusion that butter is yielded in the largest quantity, and of the best quality, by the entire milk, kept in the first place until it has become perceptibly acid. The time required for this purpose varies according to the heat of the weather, the temperature of the dairy, &c.; this point being ordinarily ascertained by the formation of a strong, thick brat, or scum, showing itself on the surface, which then becomes uneven. When fit, the milk is put into a churn, as much hot water being added to it as will bring the whole to a temperature of 65°. It is then churned at the rate of thirty-eight to forty strokes per minute, until the butter comes, which usually requires from three to three and a half hours, when the velocity is diminished in order to gather the butter.

The two following tables are given by Mr. Ballantine as showing the average results of many experiments in churning milk and cream:—

No. 1. *Entire Milk.*

Season.	Temperature of the churn at setting.	Time in churning.	Heat of the churning house.	Heat of the churn when butter came.
June, 1842.	65°	3h. 30m.	60°	68°

No. 2. *Cream only.*

Season.	Temperature of the churn at setting.	Time in churning.	Heat of the churning house.	Heat of the churn when butter came.
Oct., 1842.	55°	1h. 30m.	54°	59°

With one exception I have inserted, more or less, details of the various modes of making butter; the one to which I am about to allude is only, to the writer's knowledge, practised in the southern division of Lancashire, and the county of Chester, and very limitedly in Carlow. The practice alluded to consists in dividing the milk into two portions, viz., the greater part of the first milk is set in the ordinary way to stand for cream, the latter being usually taken off quite sweet, and the skimmed milk sold, used for the family, or given to the pigs; the latter part of the milking, which is rich in cream, is at once placed in a vessel containing the cream of prior milkings; the last drawn are locally called "afterings;" in cold weather the mixed cream and afterings are set near the fire, in order to induce acescency, provincially termed "soiling." The churn should be set at 58° or 60°, and

if smartly churned the butter will "come," sometimes within the hour, and rarely, if set at the above temperatures, will it exceed one hour and a half. In Lancashire machinery is occasionally employed for churning, and was found advantageous so long ago as 1793. Mr. Thomas Wakefield, of Brook House, near Liverpool, employed a horse machine for this purpose, by which he effected, with a horse and boy to drive, in one hour and a quarter, what was usually the labour of two men for five hours.

Quantity of New Milk. quarts.	Quantity of Butter by hand churning. lbs.
6,471	364
6,644	397
6,995	348
20,110	1,109

Quantity of New Milk. quarts.	Quantity of Butter by Machinery. lbs.
7,261	469
7,675	482
8,120	574
23,156	1,525

The above quantities of milk were the produce of six successive fortnights.

If 20,110 quarts yield 1,109 lbs. of butter, how many pounds will 23,056 quarts yield? Answer 1271; thus showing 254 lbs. of butter additional produced by machinery. This favourable action of machinery is owing to the greater number of plunges made within a given time, particularly when inanimate power like a steam-engine is employed, in which case the exact number to every minute can be regulated to the greatest nicety; forty plunges a minute is found to be the most judicious rate. In large dairies in South Lancashire small steam-engines for driving churns are by no means uncommon, the same power being also very serviceable for cutting chaff, roots, &c.

It has already been shown that milk is composed of casein, butter, sugar, water, and a small amount of inorganic salts; it has also been stated that the covering of the fatty globules of the milk is dissolved by acetic or lactic acid; seeing this, it is easy to conceive that cream or milk, a little acescent, will "*give*" the butter with less labour in churning than when the milk or cream is void of acidity. Milk, like the juice of fruits, such as the grape, apple, pear, &c., contains the principal ingredients requisite for the vinous fermentation, viz., sugar, and a protean compound —soluble albumen—the latter liable to enter into rapid changes when exposed to the influence of the oxygen of the atmosphere;

by which means it becomes converted into a ferment, which has the property of slowly, in the first instance, converting the sugar of the milk into alcohol, which latter, by further oxidation, is converted into lactic acid, the lactic acid acting upon the coating of the fatty globules as previously noticed. This action invariably takes place during warm weather, the original fermentative action being somewhat similar to that of the mode of brewing beer at a low temperature, as practised in Bavaria. Dr. Lyon Playfair has, however, stated that in winter a different action takes place, namely, that during cold weather the temperature is not sufficiently elevated to cause vinous fermentation, and that the action of the oxygen in the first instance, at this season, is confined to the casein, in other words the putrefactive fermentation takes place. It is impossible, therefore, to make good butter from milk undergoing such a change as is here named, for when incipient putrefaction has once commenced, it cannot be arrested by ordinary means, and is consequently imparted to the minute quantity of casein remaining in the butter, and is never wholly extracted; such butter speedily becomes rancid, even in winter, notwithstanding the low temperature of that season is unfavourable to the promotion of putrefactive changes.

The reason why sweet cream requires less churning than cream and milk mixed, arises from the circumstance that in cream alone the absorption of oxygen, which takes place at every agitation, is diffused throughout a much smaller quantity of liquid, the lactic acid formed is consequently much more concentrated, and acts with greater energy on the outer coating of the butter globules; butter, therefore, comes more quickly. It must be observed that, however sweet the cream may be, when placed in the churn, butter is never formed until after the formation of lactic acid. In making butter, sweet cream is a relative, rather than an absolute term, for in fact acescency commences within a few hours after the milk has been set to stand. In endeavouring to obtain butter from sweet milk alone, the labour required to form the butter is excessive, for in this instance the quantity of oxygen that can be absorbed through the influence of agitation is proportionally decreased in the ratio of the increased quantity of liquid throughout which the butter is diffused; whilst, at the same time, a larger amount of oxygen is required in order to convert a portion of the sugar of milk into alcohol, and ultimately into lactic acid. But in a closed churn a long time elapses before these changes take place: consequently, we need not be surprised to find that Dr. Traill and others failed to obtain butter from sweet milk alone; yet on one occasion the experiment was tried in Carlow, butter was obtained from new milk under the inspection of the writer, but it took upwards of five hours to produce it, and the butter

was of inferior quality, having all the characteristics of over-churned butter. The reason why it is found requisite in practice to churn milk and cream mixed at a higher temperature than cream alone, arises from the fact that temperature has a marked influence in promoting chemical changes. Reasons have already been assigned why the lactic acid, formed in milk alone, must be in a much more diluted form than that which will be found in cream slightly acescent; in order to compensate for this, a higher temperature and longer time is required to produce the desired effect.

The preceding phenomena are in strict accordance with the character of the churn used in the various districts where the lacteal products of the cow are churned in different forms. Almost invariably, certainly over the most extended area, the common barrel churn is used in those districts where cream is churned alone. By the barrel churn a large quantity of butter may be made from cream, with a moderate degree of rapidity and at a comparatively slight expenditure of labour, particularly as cream, when put into the churn, is almost invariably in some degree acescent, generally enough so for the purpose of obtaining the butter without requiring to be further oxygenized. No practical benefit is obtained by using cream quite sweet, as the increased labour required in churning far more than counterbalances any slight advantage which butter so made may derive for the purpose of keeping. If proper care is taken in "making up" the butter formed from cream slightly acescent at the time of churning, it will maintain its freshness equal to that made from fresh cream; at the same time avoiding the risk of overchurning, which will always be much greater in churning fresh than sour cream. For churning milk and cream the barrel churn is wholly inadequate, the upright churn, or one with revolving dashers, being requisite in order to sufficiently oxygenize the milk, for which purpose this form of churn is well adapted, as there always remain sufficient openings to admit the atmosphere; whereas barrel churns are hermetically sealed during the act of churning, the operation having to be stopped occasionally for the purpose of opening a vent-hole, which is occasionally done to allow the escape of the gas evolved during the "breaking" of the cream.

The American churn varies only from the ordinary square churn with revolving dashers, in the circumstance that, instead of the dashers being open, the back of the dasher is a flat piece, without any perforation, having raised edges and four transverse pieces, dividing it something similar to the shelves of a bookcase. When the dasher is turned round, the nests formed as described convey and force into the milk or cream a quantity of the atmosphere equivalent to the cubic contents of the hollow space, which

will remain in the interstices alluded to, when their edges come in contact with the fluid; in order, therefore, to produce the greatest action, the fluid ought to be on a level with the edges of those interstices: this will occur when the latter are in a perfectly horizontal position. This form of churn is the best for churning sweet cream, and will undoubtedly produce the butter from milk and cream, in any form, in much less time than any churn that has yet been introduced; but for working large masses of fluid, the labour would be excessively heavy, and in large dairies, where milk and cream are churned together, steam or other power would be required; it also remains to be yet tested on a large working scale, whether the butter will prove as good as that churned by the ordinary methods. Mr. Robinson, of Lisburn, has for some time introduced a churn from France, which is very neat and simple, and well adapted to gather the butter, having a grating for the purpose, to which also heating or cooling appliances can easily be adapted as the season or case may require.

On reviewing the whole of the circumstances connected with procuring butter, the writer is induced to give a preference to what may be termed the Lancashire method, which combines the best principles connected with the other methods. By setting aside the milk first drawn to stand for cream, the most aqueous and serous portion of the milk is got rid of, whilst by preserving the last drawn portions, and mixing it with the cream, it obtains the requisite fluidity; the acescent form in which the whole is placed in the churn is favourable to the speedy formation of the butter. Another circumstance, of no inconsiderable moment, especially in a densely populated district, such as the northern manufacturing counties, is the quality of the butter-milk thus made, which is far superior to that made from cream alone.

Churning should be regulated by a thermometer, cold water being applied in summer, and warm water in winter, to obtain the proper temperature, particulars of which have already been given. When the butter is made from cream alone, early in the morning (about 4 o'clock) is the best period of the day for the purpose. When a change is heard in the sound of the churn, and an unequal resistance is felt against the dashers, the butter may be expected to form very shortly.

After the butter is taken from the churn it must first be well squeezed or "worked" by the hand, and all the water that possibly can be, should be pressed out, it being for this purpose kneaded, washed, and rolled out several times with clean cold water, and the last time a little salt should be kneaded into the mass, which will have the effect of causing the greater part of the remaining caseous matter to exude when subsequently washed in cold water, salt appearing to have the property of dissolving

casein, as it does the albumen of bones, in pickled meats; the whole secret of Dutch butter making consists in this circumstance. If intended for very long keeping, a small quantity of saltpetre may be added, which will prevent, in a great measure, the tendency of any remaining caseous matter from entering into the putrefactive state—the cause of rancidity—the difference in quality between salt used in England and Holland having nothing to do with the superior keeping quality of the latter. If properly made, half an ounce of salt to 1 lb. of butter is sufficient if intended for keeping; and $\frac{1}{4}$ oz. of salt to the lb. if intended for immediate use. The circumstances connected with the formation of butter from clouted or scalded cream have already been sufficiently detailed; for immediate use the quality is not equal to that formed by ordinary methods, and for keeping is wholly inadmissible; the superior weight obtained is attributable to the quantity of casein and coagulated albumen, mechanically mixed with the butter, which it is impossible to eradicate by any subsequent means. The recently published report of the "Agriculture of Somerset," by Mr. T. D. Acland, relates an experiment in which a loss appeared to exist in the weight formed in making butter from scalded cream as compared with the ordinary process; this experiment, however, is contrary to all others made with the same view.

It may be important occasionally to know that a little saltpetre dissolved in warm water, and mixed with the cream taken from milk with a turnipy flavour, entirely eradicates it in the course of churning.

A factitious colour can be given to butter by the use of annatto, or the scrapings of the red part of carrots; but neither will give the appearance of fine grass butter. All such practices are to be deprecated; the latter-described mode, however, is the preferable one, in case artificial colouring is considered desirable.

Appendix.

Since the preceding treatise was written the Report of Judges appointed to inspect the Agricultural Implements shown at the Great Exhibition has appeared—on referring to which it will be found under the 6th Section (Churns) * that the order of their rapidity of action agreed according as they more or less differed from or accorded with the principles set forth in the previous essay. Still upon this point it will be well to repeat here the remark made in that report, namely, "It is not quite clear, however, whether this speed be compatible with the finest quality." In fact, the writer of this was informed by parties who witnessed the trial, that Drummond's churn lost its chance of distinction owing to the rapidity with which it was attempted to form the butter. I more particularly point out this churn, because it appears one well calculated for making butter from cream and afterings, or what I have termed the Lancashire mode.

The subject of dairy management has attracted more than usual attention at the weekly meetings of the Society; for the introduction of which many thanks are due to Captain Stanley Carr. The cheap glass milk-pans, of German manufacture, at 1*s.* 9*d.* each, or 21*s.* per dozen, are particularly deserving of attention. Passing over many minor objects noticed at the discussions alluded to, and which will be found reported in the contemporary agricultural journals, I will here take the liberty of repeating some observations made by myself on one of the occasions alluded to, respecting the construction of dairies. My recommendation—and I still adhere to it—was, that the best formed dairies should have their interior walls composed of glazed bricks, similar to those used in the construction of the model-dwellings erected in Hyde Park by his Royal Highness Prince Albert; the object being to prevent dust, the growth of fungi, &c., and the facility with which the walls could be cleaned by washing with soap and water. The floors I recommended to be composed of porous tiles or bricks, so that during the heat of summer the evaporation therefrom, if sprinkled occasionally with water, would have the effect of cooling the dairy. The last remark was made owing to the circumstance having been alluded to, that in Germany and Ireland it was invariably found that the best made butter was produced in dairies where the milk was customarily placed on the floor. To the above Professor Way added also a very ingenious reason, and one that undoubtedly holds good in degree, viz., the slower cooling of the milk when placed on shelves, in consequence of partially interrupted radiation. On all hands it was agreed that a lofty dairy-room was preferable to a low one. Lord Camoys gave a practical illustration of this. It may be well also to remark that this nobleman introduced to the notice of the Society a very neat form of metallic syphon and stand, a specimen of which can be seen at the Society's rooms.

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* Published in the last part of the 'Journal of the Royal Agricultural Society of England,' page 637.

III.—*On the Farming of Northamptonshire.* By WILLIAM BEARN, Land Valuer.

PRIZE REPORT.

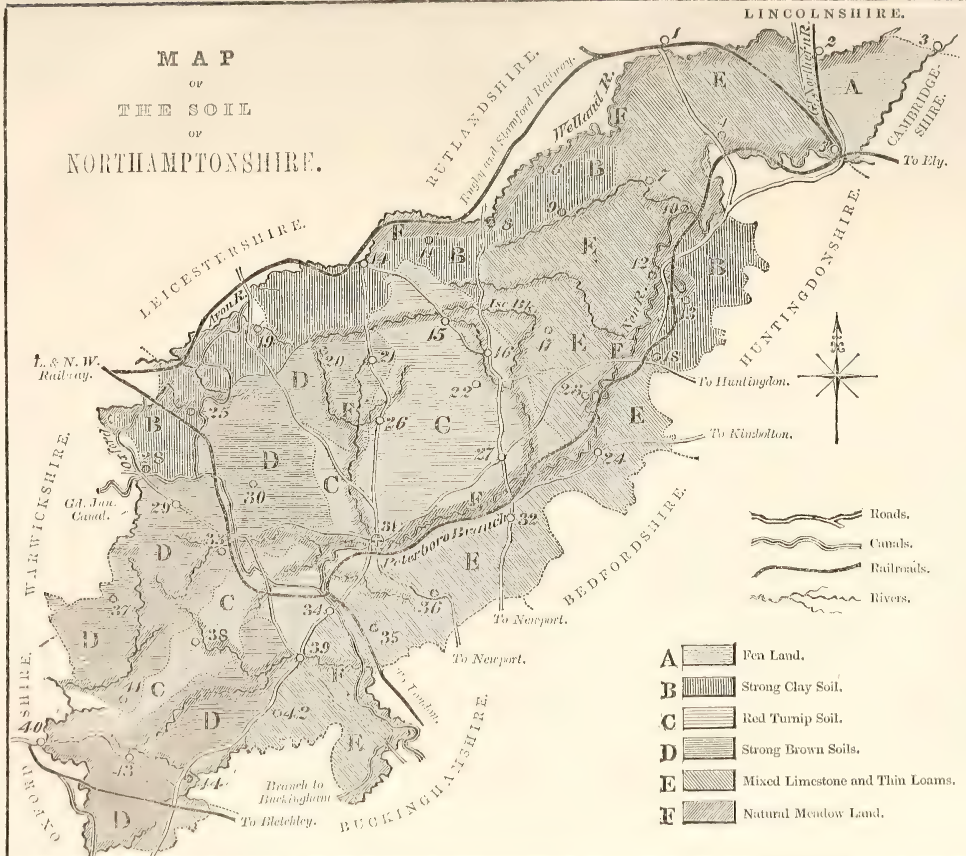
IN endeavouring to write a Report on the Farming of Northamptonshire, I feel that, as a practical tenant farmer, there may be many faults in the style of the composition; it may often lack both clearness and conciseness, and I may fail in presenting it in a popular form: still I am willing to leave it to public critics, believing that it will receive at their hands any approval it may be found to deserve, while of its numerous defects they will be candid and considerate judges.

Northamptonshire is one of the midland counties. It is of a long irregular shape; bounded on the north by the river Welland, which divides it from the adjoining counties of Lincoln and Rutland; on the east by Cambridgeshire, Hunts, and Bedfordshire; on the south by Buckinghamshire and Oxfordshire; and on the west by Warwickshire and Leicestershire. Its length from Aynho, its south-west point, to Crowland, its north-eastern extremity, is about 70 miles, and its width varies from 7 to 26 miles across. It is estimated to contain 1016 square miles, or 650,240 statute acres, about 40,000 of which are woods and forest lands. Its population in 1841 was 199,228.

The climate is generally considered favourable for vegetation and health. The surface consists of hills and dales, well watered, intersected with woodland and plantations, with many gentlemen's seats, and presents some beautiful scenery. Some of the hills in the vicinity of Daventry are very high, commanding extensive views, and range across the country in a northerly direction towards Braybrooke. The highest point in the county is supposed to be in the vicinity of Cold Ashby and Welford, and is 800 feet above the level of the sea. There is no bog or waste land to any extent, but extensive woods and forest lands, in the vicinity of Rockingham, Geddington, and Brigstock, occupying from 8000 to 10,000 acres of land; Whittlewood Forest extends 11 miles, and occupies 7000 acres, Salcey Forest and Yardley Chace about 3000 acres.

The principal rivers are the Nene and the Welland. The Nene takes its rise from two small streams, one rising in the vicinity of Naseby, and the other in the neighbourhood of Fawsley and Watford, both uniting at Northampton, where the river becomes navigable to Peterborough, and from thence flows into Cambridgeshire. The Welland rises near to Sibbertoft, and runs in a north-easterly direction, dividing the county from Leicestershire, Rutland, and Lincolnshire, and leaves the county at Crowland: it

MAP OF THE SOIL OF NORTHAMPTONSHIRE.



REFERENCE TO NUMBERS ON THE MAP.

1. Stamford.
2. Market Deeping.
3. Crowland.
4. Wansford.
5. Peterborough.
6. Harringworth.
7. King's Cliff.
8. Rockingham.
9. Great Weldon.
10. Fotheringhay.
11. Stoke.
12. Oundle.
13. Barnewell.
14. Market Harborough.
15. Rothwell.
16. Kettering.
17. Grafton.
18. Thrapston.
19. Welford.
20. Naseby.
21. Maidwell.
22. Pytchley.
23. Little Addington.
24. Higham Ferrers.
25. Crick.
26. Brixworth.
27. Wellingborough.
28. Braunston.
29. Daventry.
30. Whitton.
31. Northampton.
32. Wollaston.
33. Weedon.
34. Blisworth.
35. Road.
36. Hackleton.
37. Byfield.
38. Canons Ashby.
39. Towcester.
40. Banbury.
41. Thorpe.
42. Whittlebury.
43. Farthinghoe.
44. Brackley.

SCALE.

1 2 3 4 5 6 7 8 9 10 Miles.

is not navigable in this county. The Ouse rises from a spring called Ousewell, near to Brackley, and runs out of the county into Buckinghamshire, being joined in its course by a small stream called the Towe, at Cosgrove. The Charwell and the Leam, which form part of the western boundary, both take their rise from the locality of Charwelton near Daventry—the former leaving the county near Aynho, and the latter running into the Severn near to Staverton. The Avon rises in the parish of Naseby, and flows westward, leaving the county at Lilbourn, flowing into Warwickshire.

The Grand Junction Canal passes through the western part of the county for about 24 miles, from the Oxford Canal, near Braunston, to Cosgrove, having a branch from Blisworth to Northampton, joining the river Nene, thus making a communication with the sea at Wisbeach. There is also a branch to Stony Stratford. The Grand Union Canal extends from the Grand Junction near to Daventry, northwards to the Leicester Canal, having a bránch to Market Harborough. The Grand Junction Canal, in connexion with the navigation of the river Nene, has afforded the regular means of conveying the greater part of the surplus corn produce to Birmingham and its vicinity, and also for the transit of coals into the county.

The London and North-Western Railway runs across the county from Stoke Bruen to Kilsby, a distance of 23 miles; a branch from the main line commences at Blisworth and extends to Peterborough, running along the valley of the river Nene. The Rugby and Stamford branch of the same line enters the county from Rugby, near Lilbourn, running occasionally in and out of the county to Stamford. The Great Northern line crosses the county at Peterborough, and the Syston and Peterborough branch of the Midland connects the north part of the county with Leicestershire, Nottinghamshire, and Derbyshire. The Bletchley and Banbury branch of the North-Western runs through the southern extremity of the county from Brackley to Banbury. Since the opening of these lines of railways, the old mode of driving cattle and sheep to London has been nearly abandoned, and the surplus fat stock of the county is now principally conveyed to Smithfield by railway.

It is estimated that there are 40,000 acres of land covered with woods and plantations throughout the county, nearly 20,000 of which are occupied by the forests of Rockingham, Whittlewood, and Salcey, with their adjoining woods or chaces. From these localities annual sales of oak timber and underwood take place, but they yield a small revenue. In the woods connected with Rockingham Forest there is some very fine oak timber, wet clay land seeming to be the best adapted for the growth of the oak;

some very fine specimens of pollard oaks are to be seen on Morehay Lawn, the property of the Earl of Westmoreland, measuring from 30 to 40 feet in circumference. There are also some fine timber trees in Salcey Forest and Yardley Chace; and but very few good trees in Whittlewood Forest, which seems to have been much neglected. This forest would be more productive if it were enclosed and converted into pasture and tillage land. Application has been made to Parliament for power to enclose.

The smaller woods are generally well managed, and produce an annual income from the sales of poles and underwood, a certain portion being cut and sold every year, after 10 or 12 years' growth.

The principal geological features of the county are the different beds of the lower oolite formations. The Oxford clay, which lies between the middle and lower divisions of the oolite series, is found to the east of the valley of the river Nene, adjoining Huntingdonshire and Bedfordshire. The upper strata of the lower oolitic formation comprise the northern part of the county, and the central parts, between the valleys of the rivers Nene and Welland, extending to the south-west as far as Rockingham, thence to Kettering and Higham Ferrers, running along the south-eastern border from the latter place to Stony Stratford and Brackley, with some portions isolated or jutting out beyond this boundary. The whole of this district is generally fertile: the land is very variable, being composed principally of a thin rubbly soil, alternating with beds of clay. The middle portions of the county south-west from Kettering, including the district between Daventry and Northampton, and extending in the direction of Stowe Nine Churches and Culworth to Banbury, with the exception of intervening portions of the lias formation, are occupied by the lower oolitic series. Those parts of this district where the lower oolite approaches the surface, and where the soil is chiefly formed by the disintegration of the oolitic rocks, are well adapted for the growth of barley and turnips.

The lias formation extends along the western border of the county, from the vicinity of Catesby and Fawsley to the neighbourhood of Rockingham, running down the valley of the Welland to Stamford; it penetrates into the interior of the county along the valleys of the streams which flow into and form the river Nene. In those parts of the county where the oolitic and lias formations come in contact, the high ground is composed of the oolite and the lowlands of the lias. The position of the land where these two formations unite is generally very favourable, having a slope to the west. The soil overlying the lias, when containing a considerable proportion of the diluvium peculiar to the oolite, is frequently deep and fertile; it forms the rich grazing land in the neighbourhood of Market Harborough. At the north-

east extremity of the county is a small tract of alluvial deposit commonly called fen land; being chiefly composed of the driftings of the rivers Nene and Welland, it is very productive land.

The principal mineral productions are limestone and freestone: the former is very abundant, and is dug in many parts of the county; the latter is found at Blisworth and Kingsthorpe. At Barnach, near Peterborough, there is a large open piece of ground which has been dug over for building stone, called "Barnach Rag," and which was used in the erection of Peterborough Cathedral, some of the colleges at Cambridge, and many of the neighbouring churches. Stone is dug in the parish of Helpstone, and conveyed by water to Spalding and the Lincolnshire Fens, for the repairing of roads. Gravel is also sent from this side of the county for the same purpose. In the parish of Stanwick, near Higham Ferrers, are beds of a blueish stone used for ornamental purposes, very much resembling forest marble. At Collyweston, near Stamford, Stonesfield slate is quarried for the purposes of roofing.

Following the instructions given to competitors, I shall notice, first, the character of the soils and subsoils of the county. They may be divided into the following kinds, varying in the different admixtures:—

No. 1. Red stony soil, with a brashy, stony subsoil.
,, 2. Red sandy soil, with a sandy and clay subsoil.
,, 3. Gravelly soil, with a loose stony and sandy subsoil.
,, 4. Limestone and mixed clayey loam, with stony and marl subsoil.
,, 5. Stiff clay soil, with clay and marl subsoil.
,, 6. Moory or peaty soil, with gravelly and clay subsoil.

No. 1. *Red Stony Soil, with a Brashy, Stony Subsoil.*—This forms the principal part of the turnip land, and enters the county from Oxfordshire at Chipping Warden, running in the direction of Eydon, Byfield, Maidford, Stowe Nine Churches, and Cold Higham, taking a narrow line of country, midway between Daventry and Towcester; it continues from Cold Higham to Rothersthorpe on to Northampton, from whence it branches out in the direction of Harborough, Kettering, and Wellingborough, occasionally diverging right and left, extending northward as far as Rothwell, eastward to the vicinity of Guilsborough, and westward to Finedon and Irthlingborough. This soil varies in quality very much, some of it being weak in fertility, owing to the shallowness of the "staple," and the large proportion of brashy stones it contains. The subsoil is nearly always an admixture of red stones and sand, very porous, soon carrying off the moisture, and absorbing the manure. Draining is sometimes necessary, owing to a bed of clay obstructing the water on the side of a declivity and causing the spring water to overflow the surface.

It is not very productive of natural herbage, makes good sound sheep pasture, but does not throw up sufficient quantity of grass to afford a good bite for cattle.

No. 2. *Red Sandy Soil, with a Sandy and Clay Subsoil.*—The quantity of this description of soil is not very extensive; it is principally found in the interior of the county, extending probably about 7 or 8 miles round the county town, and even there to be found only in spots, generally at the foot of a hill, and extending into the valley. Some portions of this soil will be found in the parishes of Blisworth, Milton, Rothersthorpe, Wootton, Harleston, Duston, Dallington, Moulton, Overstone, and other neighbouring parishes. This soil may be considered as ranking the highest in natural fertility. It includes some rich pastures and meadow land, and the arable portion produces the finest crops of corn and roots. It is generally very deep in staple, possessing from 8 to 18 inches of deep alluvial soil, when the subsoil becomes more tenacious; a bed of blue clay is generally found about 3 feet below the surface. This union of the surface soil with the subsoil gives that great advantage over any other description of land, combining both fertility and strength. Whenever the subsoil is very tenacious, and the clay near the surface, this land is improved by drainage.

No. 3. *Gravelly Soil, with a loose Stony and Sandy Subsoil.*—The principal part of these soils will be found in the valleys of the rivers Nene and Welland, and by the side of the small streams in various parts of the county—the largest tract of arable land of this description at the northern extremity of the county, commencing at Peterborough and extending towards Market Deeping, including the parishes of Walton, Wenington, Glinton, Peakirk, Northborough, Maxey, and several adjoining parishes, running eastward to Carr Dyke, the old boundary between the high land and the Fen District. Small portions of the same soil will be found in several other parts of the county too numerous to particularize.

It is good working land for cultivation, but soon decomposes all vegetable manures applied to it, and is called "hungry land." When it contains a considerable portion of fine silt or sand, it is not very productive. The subsoil is principally composed of a continuance of sand and gravel with occasionally veins of clay and white marl. The sub-stratum is very porous, but is benefited by deep drainage, the water lying deep below the surface. When meadows of this soil are regularly irrigated by the overflowing of the river or brook, they grow abundant crops of grass, without any other manure.

No. 4. *Limestone and mixed Clayey Loam, with Stony and*

Marl Subsoil.—This varied admixture of soil comprises the greater part of the arable and inferior pasture-land throughout the county. It commences at the southern extremity near to Brackley, and extends to Towcester and Stony Stratford on the north-east, and to Banbury on the west. From Towcester it diverges to the east, taking nearly the whole of that side of the county south of the river Nene, from Northampton to Thrapstone (excepting small portions of woodland or peaty soils). Some of the same description of land will be found in the northern extremity of the county, in the vicinity of Etton and Helpstone, running southerly in the direction of Stamford, Kingscliffe, Brigstock, Grafton, Cranford St. John's, to Finedon, where it meets the tract of red soil. Another tract, being rather of a browner and deeper soil, commences in the interior of the county near to Maidwell and Naseby, taking a southerly course towards Watford and Daventry, and extending along the south-eastern side of the county. The limestone soil is considered the best when it is an admixture of strong loam and limestone, with a stony subsoil over a limestone rock. It then grows a very good quality of corn. The mixed clayey loam, with a stiff retentive subsoil, consisting of marl, sand, and a portion of stiff clay intervening, is not so convertible for cultivation, nor so productive, and is occasionally very shallow of soil, and liable to run together after heavy rain, thereby retarding vegetation. Draining is indispensable on the mixed clayey loams for their proper culture. This soil forms the greater part of the weak pasture-land of the county.

No. 5. *Stiff Clay Soil, with Clay and Marl Subsoil.*—The largest quantity of this soil extends along the north-western side of the county, commencing in the localities of Bulwick and Blatherwycke, extending in the direction of Haselbeech, Welford, Kilsby, Crick, to Braunston. Another tract lies on that side of the county adjoining Hunts, commencing at Titchmarch, and running northerly in the direction of Loddington and Warmington, with some small portions occasionally intervening in the aforementioned limestone and mixed clayey districts. This soil forms the strongest wheat and bean land, and also some of the richest pasture-land. The subsoil consists in some localities of a strong blue clay, and in others of a yellow, sticky, tenacious clay, with white chalky stones in it. Both of these require drainage for the profitable cultivation of the surface-soil.

No. 6. *Moory or Peaty Soil, with Gravelly and Clay Subsoil.*—The fen-land below Peterborough forms the greater part of the land of this description in the county, with some small portions in the woodland districts called "Hen mouldy land." From its loose texture it is not very productive of corn, especially that part

of it which has been reclaimed from woods, it being liable to run to straw and to grow an inferior sample of corn, and when converted into pasture soon becomes mossy and inferior. The nature of the subsoil is various: sometimes a continuance of black peaty earth, but more frequently an admixture of clay and gravel on the woodlands. The system of claying the surface, as adopted on the fenland, renders that description of soil one of the most productive in the kingdom.

On the Management of the Red, Stony, and Sandy Soils of the County, which may be considered "Stock Farms."

The most prevailing system of cultivation on this land is the four-course system of husbandry, viz.:—

1st Year—	Turnips.
2nd ,,	Barley sown with seeds.
3rd ,,	Clover.
4th ,,	Wheat.

In some districts the five-course system is followed, viz.:—

1st Year—	Turnips.
2nd ,,	Barley, with seeds.
3rd ,,	Clover.
4th ,,	Wheat.
5th ,,	Barley or oats.

Many occupiers adopt the six-course rotation, viz.:—

1st Year—	Turnips.
2nd ,,	Barley, with seeds.
3rd ,,	Clover.
4th ,,	Second year's clover.
5th ,,	Wheat.
6th ,,	Barley or oats.

The following six-course system has lately been followed, viz.:—

1st Year—	Turnips.
2nd ,,	Barley with seeds.
3rd ,,	Clover.
4th ,,	Wheat.
5th ,,	Winter beans, manured.
6th ,,	Wheat.

First Year, Turnip Fallow.—Whichever of the preceding courses of cropping is adopted, considerable attention is paid to the fallow, or turnip crop, as the foundation for the succeeding crops, both with regard to its being well manured and well pulverized and cleaned. As soon after harvest as practicable, it receives its first ploughing, and by many persons is previously

manured with long dung from the farm-yard. Early in the spring it is cross-ploughed, and in the months of May and June is again ploughed and scuffled, harrowed and rolled. All twitch grass and roots of weeds are carefully forked out, and removed or burnt, and it is got into a fine tillage. Where it has not been manured in the autumn, about 16 or 20 tons or loads of dung per acre are laid upon it before receiving the last ploughing; or in some cases the manure is applied in May and the land ploughed twice afterwards. Swede turnips are generally drilled on the surface, from 14 to 18 inches apart, directly after the last ploughing, about the latter end of May or during the month of June. As soon as the rows can be well distinguished, they are flat-hoed between the drills with a heavy hoe; and when the plants are of sufficient size, they are set out with hoes up the drills as regularly as the men can separate them. Another hoeing is given them in August, or late in July, and the plants looked over to separate any that may have been left too thick; and, should they require it, they are again hand-weeded in the autumn. Swede turnips are very liable to be attacked with the "turnip-fly," which often destroys the crop, and renders a second, or, in some cases, a third, sowing necessary.

Messrs. David and John Gaudern, of Earl's Barton, who have been very successful growers of turnips, and have repeatedly taken the prizes for the turnip crop offered by the Agricultural Book Club, have kindly given me the following information relating to the mode of managing their last year's turnip-fallow:—

"About half the field was manured soon after harvest from the feltmonger's yard,* about 10 loads per acre, which lay on the top until the middle of December, when the whole field was ploughed, and the other half top-dressed with 15 loads of well-made farm-yard manure. In April and part of May we consumed about 8 tons of mangel-wurzel per acre with sheep upon the land, giving them a small quantity of corn. The land was then ploughed very thin, and directly afterwards scarified 7 inches deep twice over, and rolled down. After lying about three weeks the land was ploughed and the seeds drilled in immediately—the rows, 18 inches apart, first horse-hoed when the plants were large enough to see the rows; then the rows were chopped through with a 9-inch hoe, leaving two or three plants together, afterwards singled by boys. When the plants got strong enough every row was gone over singly with an adze-hoe, moving all the ground. This we find effectual: the land wants nothing more doing at it. The whole expense after the seed is sown is from 10*s*. to 12*s*. per acre. We have pursued the above method some years, and find, although the hand labour is more than the ridge system, the extra weight gained per acre more than repays for the trouble."

One of the Duke of Grafton's tenants last year adopted the following mode of cultivation on his turnip-fallow. In the month

* Messrs. Gaudern are also feltmongers and woolstaplers.

of September, after a crop of oats, he commenced by scarifying the land twice over to the depth of 3 or 4 inches, then raking the stubble and grass together in heaps and burning them. The land lay in that state until the following March, when it was again scarified rather deeper. This was repeated in the months of April and May, when the land was harrowed and rolled, and the remaining pieces of couch-grass carefully picked up and burned. In the last week in June it was manured with 12 or 14 loads of farm-yard manure per acre, which was ploughed in directly, and the turnips drilled on the flat surface, the rows 18 inches apart. They came up and went on well, and were one of the best crops in the county. I had repeated opportunities of watching the plan adopted, and should consider it a very successful experiment. The scarifying kept the land fine and moist, and the dry weather in July did not seem to have affected the turnip-plants. It was on a mixed sandy and gravelly soil.

Part of the land intended for turnips is sometimes sown with rye or tares in the autumn, and consumed by sheep on the land or taken home for horses in the yard. After the tares are consumed the land is manured, receiving one or two ploughings, and if not free from couch-grass, is scarified or harrowed, and got clean, and then sown with white Norfolk, green-top, or bullock-heart turnips; these receive a similar treatment of repeated hoeing and weeding as the swede crop.

There exists some difference of opinion amongst practical men with regard to the comparative merits of the ridge and flat system of growing turnips. It has been satisfactorily proved that a greater weight per acre can be grown on the flat surface, but the ridge system has advantages in affording the liberal use of the horse-hoe during the summer, and thereby cleansing and pulverizing the soil. John Beasley, Esq., who is one of the largest turnip growers in the county, plants them rather extensively, and with considerable success, on the ridge system on his farm at Overstone.

During the last few years artificial manures have been drilled in with the turnip-seed. They have been mixed with burnt ashes and other light manures, and in many cases have been successful in assisting the rapid growth of the young turnip plant. The following experiments were made by Mr. R. Wiggins, of Orton-cum-Rothwell, in the summer of 1849:—

Experiments with Artificial Manures, by Mr. R. Wiggins, for Swede Turnips, on plots of ground 20 poles each. The whole of the produce of each plot was weighed in the second week of November, 1849. Also, produce of the succeeding crop of Barley, 1850. The whole of the root crop was taken off, and no Manure applied for the Barley, except on No. 8, part of the Turnips consumed.

Manures.	Quantity used per Acre.	Price per Acre.			Weight of Crop.				Produce of Barley Crop, 1850.		
No.		£.	s.	d.	Tns.	cwt.	qrs.	lbs.	Qr.	bus.	pks.
1. Woollen rags.	8 cwt.	1	10	0	17	16	0	0	5	1	0
2. Gelatine	5 cwt.	1	10	0	16	8	0	8	4	5	0
3. Bone manure*	12 bhls.	1	10	0	17	13	1	4	4	7	0
4. Guano	3 cwt.	1	10	0	18	15	0	24	4	5	1
5. Nitrate of soda	2 cwt. 18 lbs.	1	10	0	18	16	3	4	4	6	2
6. Superphosphate of lime .	not known.	1	10	0	14	18	1	11	4	2	2
7. Nothing	..	..			12	12	2	10	4	2	0
8. Farm-yard manure . . .	20 loads.	..			17	8	2	8	6	0	0†

The land on which these experiments were made was a thin, light soil, and had not been manured for four years previous.

In the months of October or November the white turnips are generally stocked first with lambs or shearhogs, that receive also some barley-straw, hay, or cut chaff. Many farmers separate the wether from the ewe tegs, giving the former some corn or cake in addition to hay or cut chaff; thus being enabled to bring them to market very early in the spring, and also being partly repaid for the corn in the increased value of the succeeding barley crop. The ewes are permitted either to follow the lambs in the turnip-field to pick up what they leave, or a portion of the crop is carted off and given to them on the grass-land.

Swede turnips, being better able to stand the severity of the frost, are not stocked until after the white crop is consumed, when the sheep are put upon them; the shearhog sheep receiving about a pint of beans or pease per day, or a portion of oil-cake, cut chaff, clover, or meadow hay. On good sound land and by a supply of food they make rapid progress, and will be ready for the butcher in the months of March and April. The wether tegs also, when supplied with corn or cake in addition to swede turnips, will be ready to be shorn and sent to market in May,—a system very generally adopted by many first-rate occupiers of

* The bones were first dissolved with sulphuric acid, and mixed with gypsum and agricultural salt, and then measured in that state.

† On No. 8 two-thirds of the turnips was consumed on the land.

turnip-farms. The ewes have, previously to the lambing season, a daily supply of swedes. In the consumption of the swede crop, the most prevailing custom is to get the turnips up, to cut off the roots and tops, and to place them in heaps, covering them over with straw and a slight covering of mould. The advantage of this plan is, the more economical consumption of the crop, and the teeth of the sheep are not injured by the hard state of turnips during frosty weather. When given to the sheep from the heaps, they are cut with a "Gardner's turnip-cutter," and placed in troughs, from which the sheep will eat them with great avidity. A full crop of swede turnips will carry from 12 to 16 sheep per acre for 20 weeks; and if a liberal supply of corn, hay, or chaff is added, 20 sheep per acre may be kept for that period.

The principal kinds of swede turnips grown are "Skirving," "Matson," and purple-top. There has also been of late years a great variety of hybrids introduced.

In addition to the turnip-crop, mangolds and cabbages are likewise grown on some portions of the fallow, the land receiving the same mode of cultivation as for the turnip-crop. The mangold being sown in April, the land does not often get more than one or two spring ploughings. The seed is generally dibbled or drilled in rows, 20 to 24 inches apart, and, when the plants are up, they are singled out by hand, and kept free from weeds by repeated hoeings either by hand or the horse-hoe. In November the roots are generally stored in long pits, covered over with straw and earth, until the spring, when they are very valuable for milking-cows or lambing-ewes. It cannot be considered good food for stock before March, and is even better in April; cattle and sheep should be gradually accustomed to it, being more relaxing than turnips, and requiring a liberal supply of dry food to be given with it. The yellow globe and the long red are both grown, but the yellow globe the most extensively. Cabbages are planted by hand in rows about 30 inches apart, and the plants about 30 inches asunder in the rows. They require good deep soil, which should be in high condition. The drum-head winter plants are mostly grown, and are very valuable to draw off for breeding ewes, or to give to lambs in autumn with a supply of corn and hay. Spring plants are also cultivated, and planted to come in after the winter cabbages are consumed.

Second Year, Barley.—After the turnips are consumed the land receives one thin ploughing; barley being a slight-rooted plant, and the manure of the sheep forming the principal support of this crop, it is not considered advantageous to bury it very deeply. Barley-seeding commences, in favourable weather, in March, and is continued into April, in order to keep the sheep at turnips as long as practicable; but the more general

plan is not to defer sowing the barley longer than the middle of April, but to cart the remaining turnips off the land, to be consumed on grass-land or on the next year's fallow. Barley is often sowed broadcast and harrowed in, but in some districts a considerable portion is drilled; seed used about 3 bushels per acre if drilled, and an additional ½ bushel if sown broadcast. Clover-seeds are sown either at the time the barley is put in, or are deferred until the barley is up; the former plan is the most prevalent and is considered the most certain, especially if dry weather succeed the sowing. The barley crop does not often require much weeding, but suffers on the sandy land from "golding," a weed that rises up late in the crop and is very difficult to eradicate.* Chevalier and American barley are the two kinds most commonly grown. The straw, when well harvested, and having with it an admixture of young clover, makes good fodder for beasts or sheep in the winter months.

Third Year, Clover Seed.—Red broad clover is not very often sown alone on this description of soil, but with an admixture of red clover, white Dutch, trefoil, and rye-grass. The following quantities of the different kinds are in use throughout the county, but many persons vary the proportions of each kind:—

No. 1.	18 lbs. of red clover . . ½ bushel rye grass . .	This is adapted for mowing.
No. 2.	10 lbs. of red clover . . 6 lbs. of white ditto . . 4 lbs. of trefoil . . . 1 peck of grass . . .	This mixture is generally grazed.
No. 3.	8 lbs. of red clover . . 8 lbs. of white ditto . . 2 lbs. of trefoil . . . 1 gallon of rye grass .	This is also for grazing, and some persons omit the grass altogether.

A small part of the seeds grown is often mown for hay; but some farmers, who have a fair share of meadow-land with their occupation, graze their seeds during the summer, folding the sheep during the night, and giving them a daily supply of corn or cake. Mowing the seeds seems to be as beneficial to the succeeding crops of wheat as grazing them. This is accounted for by the fact that, when the clover-plant is left to be mown, the roots of the clover assist in supporting the wheat-plant, as they grow larger than when seeds are eaten. Should the seeds fail of

* If this weed be the same with the corn-marigold, which is very troublesome in this neighbourhood on a limited tract of fine sandy soil, it may be worth the trial to apply a moderate dose of lime, say 10 quarters per acre. Mr. Edmunds, of Longworth Lodge, near Abingdon, having used that dressing, found no other benefit indeed, but, to his surprise, has not been troubled with this very unmanageable weed since.—PH. PUSEY.

plant, or any portion "go-off" in the spring, the land is sown with early pease, winter beans, or white turnips, to be eaten off early.

Fourth Year, Wheat.—Early in October the clover-ley is ploughed up, about 5 inches deep, for wheat; this is generally done by two horses abreast. Some persons have a presser following the plough teams, pressing down the furrows and making a groove, into which the seed, being sown broadcast, falls and finds a firm bottom; it is then harrowed in. A field, when well ploughed and pressed, presents a very nice appearance, showing a regular ribbed surface. When a presser is not used, the land is rolled down after ploughing with a heavy roll or Crosskill's clod-crusher, and the seed drilled; or, if the weather is suitable, the seed is harrowed in, and the land rolled afterwards. The seed used varies from 2 to 3 bushels per acre, according to the condition of the land and the time of sowing.

On this description of land, having a northern aspect, and when the soil is thin, the wheat often loses plant in the spring, occasioned by the rain during the winter months washing the mould from the roots of the plants, and the severe frosts in the spring destroying the wheat. It is also liable to suffer from wireworms and grubs. Dibbling of wheat has been practised to some extent. The seed saved was considered nearly to compensate for the extra labour when the price of wheat was 7*s.* per bushel. When a dibbling machine is not used the work is performed by a man, with two iron dibbles, walking backwards and making the holes, into which the seed is deposited by boys, over which a light harrow is then passed.

There is great difficulty in getting the work well executed; the boys are apt to drop the seed very irregularly, and it comes up in small bunches. It is an advantage to the light land, in consequence of the soil being pressed down firmly by the treading of the men and boys in the execution of the work. I saw a small field in the parish of Eydon last summer that had been planted with a hand dibbling machine, but it was much too thin and a very unproductive crop. Dibbled wheat has always a great tendency to tiller in the spring, and thereby produces an uneven sample; the crop also is more likely to mildew. With the present price of wheat, dibbling is likely to become less practised, as the saving of seed will not compensate for the extra labour.

The preparation of seed wheat before sowing is very varied. The old system of brining is still very prevalent, the brine being made sufficiently strong to swim an egg. The wheat is put into it, and the light grains are skimmed off. The wheat is then placed on a dry floor, and mixed with a small quantity of fresh lime. Wheat, thus prepared, when the atmosphere is damp is

apt to become raw, and not to run freely down the pipes of the drill. Wheat is also "puddled" after the following manner. A sack of wheat is shot down upon a floor, and about 3 gallons of boiling water, made thick with quick lime, is poured over it; the whole is then mixed together by repeated turnings, and left about 12 hours to dry. A solution of ½ a lb. of blue vitriol, dissolved in hot water, to 4 bushels of wheat, is now becoming very general, it being less trouble and more cleanly than the preceding plans, and equally efficacious as a preventive to the smut.

Wheat after clover-ley is generally very free from weeds, unless it loses plant in the spring; it then requires hoeing, and often hand-weeding. Some farmers regularly hoe all their wheat in April or May.

The principal kinds of wheat grown are the old brown Lammas, clover wheat, Bristol red, and Spalding prolific wheat.

When the four-course system is regularly adopted, the preceding wheat crop is the last one in the course, and the land is then prepared for the fallow crop; but some farmers follow the five-course system, and the succeeding crop will be—

Fifth Year, Barley or Oats.—In some districts this system is regularly followed. The wheat stubble receives a slight dressing of manure, or is folded with sheep during the harvest, and in the months of November or December is ploughed up, lying all the winter months, and the barley or oats drilled on the stale furrow in the spring. If the land should not be quite clean, another ploughing is given in the month of March, and the land scarified or drag-harrowed and hand-picked over before the barley or oats are sown.

Whenever the six-course system is adopted, winter beans would be sown instead of barley, the land manured and the beans drilled about the first week in November, in rows 18 or 20 inches apart, well hoed, and cleaned during the summer, either with the horse-hoe or hand-hoe. They are generally ripe in August, leaving the land in good condition for wheat.

Sixth Year, Wheat.—This crop follows the winter beans. The land, having been manured the previous autumn, will plough up in good condition for the wheat crop. It is generally well scarified and cleaned, and the wheat drilled or sown broadcast, and harrowed in.

The other six-course system referred to, where the seeds are permitted to lie down two years, is followed by persons who are short of pasture land; it affords rest to the land, and the wheat crop is thereby thrown at wider intervals.

The preceding rotation of crops may be considered as the systems most generally adopted throughout the county. There are many very excellent farmers around Northampton who farm

very highly, and do not follow any regular system of cropping. They sow every year that crop they consider likely to be the most productive, and for which the state of the land and the season seem to be adapted. I have seen the following system tried, for successive years:—1, turnips; 2, wheat, sown in February; 3, clover; 4, wheat; 5, barley. And also the following:—1, turnips; 2, barley; 3, barley sown with seeds; 4, clover; 5, wheat.

On this land stock-feeding forms a very considerable portion of the produce of the farm; the turnips in winter and the seeds in summer, with a portion of natural herbage, enables the occupier to keep a considerable quantity of stock on the land. Sheep form the principal stock. A breeding flock of ewes is generally kept, and the lambs are either sold from the turnip-pens, one year old, or kept and shorn, and made off fat, early in the summer. When a breeding flock is not kept, lambs and shear-hogs are bought in at Michaelmas and made fat on turnips, or during the ensuing summer; or ewes are purchased for the purpose of rearing lambs, and both sold off, fat, during the year, and replaced every season.

The neat cattle consists often of cows kept for the dairy, bought in as heifers, milked a few years and then sold out again, down calving or made fat for the butcher. When cows are not kept for the dairy, beasts or barren cows are purchased in the winter to consume the straw, receiving in addition some turnips or oil-cake. They are turned out in the summer on the grass land to get fat, or sold in the spring to the grazier. Some farmers purchase half-meaty cows in the autumn and put them into the stalls; these are fed on swede turnips, barley or bean meal, and hay, with an addition of oil-cake towards the latter part of the season.

Some few years ago, upon the recommendation of Mr. Warnes, the Rev. Sir George Robinson, Bart., and other gentlemen commenced the growth of linseed for cattle, but it was not very successful, owing to the want of suitable machinery to convert the fibre into flax, and is now almost abandoned. I have understood that Mr. Wallis, of Rowell Lodge, continues to grow it, and he, in connexion with other occupiers near Kettering, has commenced the growth of chicory.

Since the disease in the potatoes the growth of them has decreased. They are grown extensively around Northampton for the supply of the town, but are not much cultivated in other parts of the county, except for the table, being considered great exhausters of the soil. They are principally cultivated by spade labour in gardens, or the corners of ploughed fields; occasionally they are ploughed in, the seed being deposited by boys, and covered over by the furrow.

There is a great variety of sorts, but the Duston Reds, Early Shaw, Pink-Eyed, Kidney, Purple, and Farmers' Glory, are the kinds principally grown.

Carrots are grown on some of the deep sandy land around Northampton, principally for sale, by small occupiers. I saw a few acres growing in a field at Eydon, in the occupation of the Rev. F. Clarke. Mr. J. Beggs, of Desborough, has also been a very successful grower of carrots, but they are not cultivated throughout the Red Land district to any considerable extent.

The average yield of corn on this description of land may be estimated at 32 bushels of wheat, 44 bushels of barley, and 48 bushels of oats, per acre.

On the Management of the Heavy Soils, including "Gravelly, Limestone, and Mixed Clayey," and the Stiff Clay Soils.

These soils, for the greater part, come under the same system of cultivation, with some little alteration in various localities according to the natural capabilities of the soil, aided, as they may be, by superior cultivation. I have, therefore, classed them together, considering that I shall carry out more effectually the design of this Essay by giving an outline of the general system of farming, than by merely giving accounts of individual systems, or private experiments relative to cultivation.

As the most prevailing system, I shall place the four-course first:—

No. 1.	1st Year—	Fallow.
	2nd ,,	Wheat.
	3rd ,,	One-eighth beans, one-eighth clover.
	4th ,,	Wheat, barley, or oats.

Or the following:—

No. 2.	1st Year—	Fallow.
	2nd ,,	Barley.
	3rd ,,	One-eighth beans, one-eighth clover.
	4th ,,	Wheat.

In some districts the following five-course system is adopted:—

No. 3.	1st Year—	Fallow.
	2nd ,,	Barley.
	3rd ,,	Clover.
	4th ,,	Wheat.
	5th ,,	Beans or oats.

Many occupiers of good arable land, with an extra supply of manure, will take the six-course, as follows:—

No. 4.	1st Year—	Fallow.
	2nd ,,	Barley.
	3rd ,,	Clover.
	4th ,,	Wheat.
	5th ,,	Beans, manured.
	6th ,,	Wheat.

In explaining the mode of cultivation, I shall include both No. 1 and 2 under one head, as the same system of husbandry is adopted, excepting that barley is taken in No. 2 directly after the fallow, and in No. 1 the barley or oats is taken as the last crop, and in some instances wheat is again taken.

First Year, Fallow.—A considerable breadth of this description of land is sown with tares. They are sown as early after harvest as possible, the land receiving one ploughing, and the seed about 3 bushels per acre, either harrowed in or drilled. These are either eaten off with sheep, or mown for horses in the months of May and June, after which the land receives two or three ploughings, is scarified, manured, or folded with sheep, and is either sown with wheat at Michaelmas or laid up dry for barley in the spring. When an entire dead fallow is intended, the first ploughing is sometimes given in the winter months, but most frequently it is deferred until April or May, as on all wet soils a dry first ploughing is almost indispensable to the making of a good tillage. The second ploughing is generally given across in the month of June, and the land left in a rough state "to bake," that is, to be dried up by the summer's sun, thereby killing the roots of couch grass and other weeds; after which it receives two more ploughings, or one ploughing and twice scarified; it is then manured or folded, and made into a fine clean tilth, ready for wheat or barley.

Of late years turnips have been grown on some parts of the summer fallow, choosing those fields on the farm which are the best adapted for root crops, as they come in rotation to be fallowed. The first ploughing is given in winter, and the land is sometimes previously manured. Early in the spring it is again ploughed, and, if necessary, scarified and rolled with Crosskill's clod-crusher; and by repeated ploughings is got into as fine a tilth as practicable. It is manured previous to the last ploughing. The turnips are drilled in June or July, either on the flat surface and hand-hoed, or on ridges, which are kept clean by repeated horse-hoeing. Under a system of high farming, good crops of turnips may be obtained on the most convertible part of these soils; but it is difficult to consume them on the land, owing to the treading of the sheep rendering the land unfit for the succeeding crop of barley. Many farmers get them up in the autumn, and consume them at home in fold-yards or on the grass-land, ploughing the land up for exposure to the winter's pulverization. An improved system of drainage has much increased the facility of growing root-crops on the stiff soils. On the gravelly soils turnips can be eaten off by sheep with advantage. The Right Hon. C. Arbuthnot, who farmed extensively on a

limestone soil at Woodford, had for many years grown turnips on the ridge system on all his fallow land.

Mr. James Webster, of Peakirk, who farms extensively on a deep black gravelly soil, has been substituting a crop of winter beans and turnips as the fallow crop. The winter beans are drilled in rows 27 inches apart; in the spring the beans are horse-hoed between the rows two or three times at intervals; and in the latter end of June the turnips are drilled with a barrow-drill drawn by a man, and a boy guiding it. The beans are pulled up by women and children at an expense of 5*s.* to 6*s.* per acre, and tied up and carted home. The turnips are then hand-hoed and set out in the rows, and the land occupied by the beans well horse-hoed. I saw a crop of turnips thus grown this year, and Mr. W. informed me that he had now adopted the system for four years, and had grown upon the average 4 quarters of beans and 16 tons of hybrid turnips per acre; and he considers by the consumption of the turnips on the land, with the addition of some corn, that the land was in high condition for the succeeding crop of barley.

Mangold is grown on part of the fallow to some extent in different parts of Northamptonshire. Mr. Thos. Robinson, farm-bailiff to the Marquis of Northampton, at Castle Ashby, on a mixed limestone and clayey soil, has communicated to me the plan he pursued last year in the cultivation of mangold. The land was manured at the rate of 16 or 18 tons of good farmyard manure in March, and the manure ploughed in as soon as possible to the depth of 7 or 8 inches. About three weeks before sowing the mangold, about 8 cwt. per acre of pigeon and hen-roost dung, mixed with soot, was sown broadcast and harrowed in. The seed was planted about the middle of April, in holes drawn out with a hoe, the distance between each hole being 18 inches. The rows were 18 inches apart, thus making the plants to stand 18 inches apart each way. The plants were hoed, leaving two or three plants until the next hoeing, then singling them out. The weight per acre was upwards of 28 tons.

Carrots are grown, not to any extent, yet occasionally on a piece of deep soil. The land is either dug or subsoiled with a subsoil plough. They are generally sown or drilled on the flat surface. Mr. J. Robinson, of Castle Ashby, was the successful winner of the carrot sweepstakes last year at Northampton, and the following was the system of cultivation he adopted.

The land was ploughed and subsoiled to the depth of 12 to 14 inches in the month of February; the carrots were sown by hand in the first week in April, in drills drawn by hand, 1 foot apart. The seed was mixed with dry ashes to make it separate

more freely. The plants were left rather thick in the rows, about 4 or 5 inches asunder, and kept clean during the summer. The weight was 24 tons per acre; they were grown without any manure and after a wheat crop.

On the same farm, in the year 1847, Mr. Robinson took the prize for both carrots and mangold; the weight of carrots was 32½ tons, of mangold 34 tons per acre. I mention these facts to show what may be done on inferior land by steady perseverance and skill.

Second Year, Wheat or Barley.—On the stiff clay land, after the summer fallow a crop of wheat is generally taken; but in some districts, where the land is drier and a crop of turnips has been taken, the land is left for barley. If wheat is taken first, it requires on tillage land but little cultivation before sowing; it is either ploughed in with the last ploughing or is drilled. The seed used is about 2 bushels per acre, but on some weak land 2½ bushels are sown. The furrows are drawn after the seeding is done, and trenched to carry off the water. During the spring months clover is sometimes sown on part of the land, and harrowed in with a pair of light seed harrows. The crop will not often require much attention during the summer, except hand-weeding, and even this is not always done. Should the land have been left for barley, it is nearly always drilled on the stale furrow, without the land being again ploughed. Clover seeds are harrowed in, and should clover not be sown, the barley is generally hoed as soon as it is ready, or hand-weeded during the summer.

Third Year, Beans or Clover.—When the occupier is regularly following the four-course system of husbandry, he generally sows one eighth part of his arable land with clover and one eighth with beans, thus bringing in the clover at an interval of eight years. The clover plant in the wheat or barley stubble is eaten by a few lambs at Michaelmas, and is shut up during the winter. The wheat stubble is not mown, but left to protect the clover plants, and then raked off in the spring. The clover is either mown for hay and then grazed with sheep, or else mown twice for hay. When clover-seed is grown, the seeds are eaten until May, and then shut up for "maiden seed;" or a crop of seed is sometimes taken after the mowing, but it is not so productive, and is liable to be injured by the frosty nights in autumn. Considerable quantity of clover-seed used to be grown in the vicinity of Finedon, Great and Little Addington, Woodford, Raunds, and on the limestone land in that vicinity. I have known as much as 8 bushels of maiden-seed per acre grown on the farm now in the occupation of Mr. Wakefield of Finedon, the property of Captain Purvis.

Red broad clover is principally grown on these soils, with

occasionally a mixture of rye-grass and trefoil. Quantity of seed sown from 16 lbs. to 20 lbs. per acre.

When clover is not taken, the land left for beans is manured in the winter, and receives one ploughing early in the spring, or as soon as the weather will permit the manure to be carted upon it. The beans are either drilled or dibbled in rows varying from 12 to 18 inches apart; as soon as they are well up, they are hand or horse hoed, and kept clean all the summer, having two hoeings, and the charlock and other weeds pulled up by hand. Some persons let their bean crop to be twice hoed and once hand-weeded, at from 7*s.* to 9*s.* per acre, according to the state of the land.

Previous to the clover-ley and bean stubbles being ploughed up on land subject to the slugs, a small quantity of lime or salt is sown on the stubbles before they are ploughed up. This is found very successful when done early on a damp morning—the smallest quantity of either quick-lime or salt falling on the slugs soon destroys them. When this plan is not adopted, and the slugs are found to be destroying the wheat blade, lime is sown on the land; but it is not so efficacious as the former plan, as the slugs lying under the furrows are protected from the lime. They are very destructive in wet, open seasons, and the wheat is frequently obliged to be sown again in spring.

The quantity of seed-beans used is from 2½ to 3½ bushels per acre, being regulated by the width of the rows apart.

Fourth Year, Wheat, Barley, or Oats.—When wheat has been taken after the fallow crop, it is only on the best description of cold land, and which has been well farmed, that wheat is again taken; but yet this system has become more frequent, and is increasing every year, for as the land gets well manured for beans or else is a clover-ley, wheat may again be sown with success, assuming the land to be clean. On the thin weak land, which has probably had a very light dressing for the bean-crop, and, in some cases, none at all, the land gets one ploughing in November or December, as the season is suitable, lying all winter, and barley or oats drilled in on the stale furrow in the spring, the soil sometimes being moved on the surface by a slight scuffling or harrowing; when the seed is not drilled it is generally harrowed in. This crop requires to be well hoed or hand-weeded during the summer, and receives a more liberal supply of seed.

In the southern part of the county, in the vicinity of Towcester and Brackley, it has been usual to give the barley-land, after beans, another ploughing in the spring; should the season be suitable it affords an opportunity of cleansing the land, but more frequently it is an additional expense without any increase of produce. I have seen some land so wet and raw after the

second ploughing that the horses could not go on it for three or four weeks, and should dry weather set in, the land becomes like brickbats; and before Crosskill's clod-crushers were invented men were employed with wooden beetles to break the clods. Where the land is clean, it is now more general to sow without again ploughing: it affords an earlier opportunity of getting the seed into the ground, and prevents an additional expense in labour. Oats are not grown to any great extent in this county; when they are grown, they generally come in this rotation of the four-course system, the land receiving the same cultivation as for barley. The quantity of seed varies from 4 to 6 bushels per acre. Oats are sometimes used by farmers who wish to crop their land as long as it will produce a crop, and then oats come to their relief; for it is a universally admitted opinion in this county that *when a man has his land in that position that he knows not what to sow next, he may grow oats.*

This would be the last crop under the four-course system; I shall now refer to the five and six years' course of cropping.

Fifth Year, Beans or Peas.—Under the five years' regular course of fallow, barley, clover, wheat, the last crop is generally beans; the same mode of cultivation is followed as I have already referred to. On some land of a shallow soil maple-peas are substituted for beans; they are drilled in rows 12 to 16 inches apart, and well hoed during the summer; seed used about 4 bushels per acre. They are a very precarious crop, owing to their liability to be injured by the green flies when in flower; the straw, when well gotten, makes good fodder for horses and cattle. In some localities beans and peas are grown together; the peas are a large kind, called the "old maple," and grow very long in the straw, entwining themselves around the beans.

Sixth Year, Wheat.—Under a superior system of cultivation, another crop of wheat is taken after the beans or pease. It is very generally adopted on the deep gravelly soils below Peterborough, but it is not done to any considerable extent on cold wet land, owing to the difficulty of keeping it clean and in convertible tillage without having recourse to a summer fallow.

Many farmers have been trying to dispense with a naked fallow altogether, by following a succession of alternate grain and pulse crops. I have been on land that has not, for the last twelve or fourteen years, had a naked fallow, where that mode of cultivation has been very successful. Mr. Underwood, of Brixworth, informed me that he has some stiff land in his occupation that has been in a continued course of cropping for ten years, and he considered the last crop of wheat the best. Mr. Samuel Taverner showed me a field on his farm at Peterborough, that had grown white and pulse crops alternately for eight successive years.

Many persons contend that on the stiff clay soils the succeeding crops repay for the loss of the year's fallow; but very much depends upon the mode of cultivation and the nature of the soil. In going over the farm of Mr. Josh. Elkins, a tenant of Earl Spencer's, at Elkington, upon noticing that he cropped his land rather hard and yet *kept it clean*, he informed me that he adopted the plan *of going over his stubbles in the autumn, and forking the twitch out before ploughing the land;* and by regularly pursuing that plan, and with a liberal supply of manure and lime, he had taken *six crops in succession.*

I have seen, during the last year or two, the plan adopted in many parts of the county of paring or scarifying the stubble in the autumn, and I have no doubt that it is very advantageous for keeping the land clean; it operates very beneficially in checking the growth of couch-grass, which, if permitted to remain in the land until the ensuing spring, will spread its roots rapidly along the surface, and every month it will increase in strength and vigour, and become much more expensive and difficult to separate from the soil. If a little attention were paid yearly to pick out the small patches of couch-grass and roots of docks, &c., a considerable reduction of labour would be saved when the land comes to be fallowed. *More good may sometimes be done in a dry autumn than can be done during the entire summer, if it be a showery one.* For the reduction of annual weeds we must look to the hoe and hand-weeding, combined with good crops of corn; for, if the corn is strong and vigorous, the weeds will give way. If more attention was given to the weeding of the bean and other pulse crops, that wide-spreading flower "the yellow charlock" would not present so luxuriant an appearance in our different crops of spring corn.

White mustard has of late years been sown on fallow land and ploughed in, as a preparation for the wheat crop. Mr. Peter Love, of Naseby Manor Farm, speaks very highly of it, and has grown two or three crops of it in succession on the summer's fallow, which have been eaten off by sheep; the land after this treatment producing an abundant crop of wheat. There seems some risk in allowing cattle and sheep to eat *too much* of it, but Mr. Watts, of Scaldwell, one of the first farmers to introduce the practice in this county, having mown some part of it, and taken it home for his horses, for which purpose he used to employ a bull to draw the cart; and perceiving one day that the bull ate it very heartily, assumed that *the cows would do the same*, and while it lasted he gave a portion every day to the cow stock. It is also sown after a crop of pease is off, and then ploughed in as manure for the succeeding crop; when it grows very luxuriantly and the crop is very high, it is rolled down with

a heavy roll, and a chain hung on the coulter of the plough to cause it to be covered over by the furrow.

The heavy soil of this county is frequently laid in lands, some of them very crooked and "high-backed," having a serpentine form with deep furrows, up which the drain is generally placed. Draining of this soil is absolutely indispensable for its cultivation, except the limestone soils on a limestone rock, or the deep gravelly soils. I have been more particular in describing the cultivation of the heavy soils, because they form the greater part of the land of the county, and also because there is more difference in their management than on the red turnip-soils, owing to their varied and changeful character. The most prevailing custom is to take three crops after the fallow, one of them to be pulse; where this is departed from, the land is generally of a superior quality, or receives a greater amount of expense in cultivation. Whenever a system of cross-cropping is carried out by repeated crops of white corn the land is soon exhausted, and it is both injurious to the land and unprofitable to the occupier. To sow land out of condition is always a losing game, and a more generous and liberal mode of cultivation is the most profitable to the occupier and more beneficial to the community.

At harvest, wheat is principally reaped at prices varying from 8*s.* to 15*s.* per acre, according to the bulk of the crop. In the northern part of the county, adjoining Lincolnshire, many farmers mow all their wheat: the *swarth*, falling *towards* the standing corn, keeps the ears from the ground; one man mowing, and another man following to tie up; or a man is often assisted by his wife, who, following him, takes the corn, laying it down in sheaves; the man tying it up as he returns, and the woman carrying back the scythe; the work done at from 8*s.* to 12*s.* per acre. Mr. Webster, of Peakirk, who adopts this plan, informed me that the great advantage of mowing wheat was, that when the corn was cut, and set up in rows about 20 yards apart, it gave him an opportunity of setting his scarifier to work, and preparing the ground for the ensuing crop of winter beans.

Wheat, when carried, is generally set on post-hovels or made into round cobs, the outsides being pared, and, when thatched, present a very uniform and neat appearance. Great attention is paid in some localities to the neatness of the "rick-yards," but in others they often present an untidy and loose appearance.

Barley and oats are mown and carried loose to the barn or stock-yard; the price for mowing is from 2*s.* 6*d.* to 3*s.* 6*d.* per acre. Beans are hooked, when strong and bulky, at 6*s.* to 8*s.* per acre. Peas are also hooked or mown at prices from 4*s.* to 6*s.* per acre; but a great portion of the harvest work is done by

men hired for the month, at wages from 15*s*. to 21*s*. per week, with a daily supply of beer.

From the great variety of these soils, it is impossible to state very accurately the annual produce per acre, but the following estimated average yield may be taken as a fair proportion: wheat, 28 bushels; barley, 34 bushels; oats, 40 bushels; beans, 24 bushels; peas, 24 bushels. Seed vetches are not grown very extensively; small portions of the crop are sometimes left for seed, and in some districts, favourable for their growth, they are cultivated instead of beans or peas.

The number and description of stock kept on heavy land is regulated by the quantity of grass or meadow land connected therewith. When but a small portion of grass-land is occupied with a cold arable farm, beasts are generally wintered in the straw-yard on the barley, oat, and bean-straw, and sold again in the spring to the grazier. When no oil-cake or roots are used, the manure thus made is of very inferior quality, and accounts for the very low condition and slight corn-crops on this description of soil; the corn being all sold off the land, and only a team of horses and a few straw-yard beasts kept to supply the annual amount of farm-yard manure. In other cases, where a greater extent of grass-land is occupied with the arable, a breeding flock of sheep is kept, receiving aid from the arable land, by means of the seeds, tares, and a small quantity of turnips, mangold, or cabbages, giving in return the manure from the sheepfold. The lambs reared are sold at Michaelmas, the ewes lying then on the grass land during the winter, and, at the lambing season, they are brought to the fold-yard, and receive some oats, hay, or a daily supply of roots. A dairy of milking-cows is sometimes kept on the grass-land during the summer, and put into the straw-yard in the winter with a supply of hay.

In order to increase the quantity and quality of the manure, pig-feeding is resorted to by farmers to a considerable extent. I know several large occupiers who convert a large proportion of their spring corn into pork, and are satisfied if they get the extra manure for the expense of the daily attendance upon the pigs.

On the Management of the Moory or Peaty Soils, with Gravelly and Clay Subsoils.

The proportion of this description of land, commonly called in this county "hen mouldy land," is very small, and is principally found in the woodland districts and on Burton Wold, with some small plots on the outskirts of the county adjoining Bedfordshire; from its not being adapted for the growth of pulse

crops, there is not much latitude for a rotation of crops, but the following system is the most prevailing :—

1st Year—Fallow, with root-crops.
2nd ,, Wheat.
3rd ,, Oats.

or the following :—

1st Year—Fallow, with root-crops.
2nd ,, Oats.
3rd ,, Seeds.
4th ,, Wheat.

It is not necessary again to repeat the system of ploughing and preparing the land for the different crops, as it is similar to that followed on the heavy land. On the fallow-crop either turnips, cabbages, mangold, or potatoes will grow very successfully; but if the subsoil is too tenacious, and not well drained, it is difficult in a wet season to consume them on the land, and they are often drawn off in the autumn.

Many occupiers of this soil follow a system of alternate wheat and root crops, and they consider that the most profitable. By an application of manure to the root crops and lime to the wheat crop, a considerable annual produce may be obtained. The lime has a tendency to destroy the wireworm and other insects, which are often very destructive on this soil.

The small district of fen-land commencing about a mile from Peterborough, on the road to Eye, bounded on the west by "Carr Dyke," and on the east by "Catwater Drain," extending northward to Crowland, and occupying about 10,000 acres, may very properly be placed under this division.

The west side of the fen district is a very deep alluvial deposit, and a very productive soil; the land becomes more light and spongy as it approaches the eastern boundary of the county.

The three principal divisions are, Peterborough Flag-fen, Newborough, and Borough Fen.

Previous to the enclosure which was executed in 1814, Peterborough Flag-fen and Newborough were "common right land," the former belonging to the "commoners" of the city of Peterborough, and the latter being "common right" belonging to the thirty-two parishes comprising the soke of Peterborough; consequently, at the time of the enclosure the land was parcelled out into almost numberless allotments, varying in size from less than 1 acre to 10 or 12 acres. In going over this land I found it impossible to give any definite account of the system of cropping pursued. Generally, on a moderate-sized field the following course of cultivation is pursued: 1, Coleseed; 2, Oats; 3, Wheat; 4, Seed; 5, Wheat; but in the smaller allotments wheat and green crops are grown alternately. I was referred to

one piece of land on which wheat and potatoes had been grown every other year for the last twenty years. Some of the small allotments have cottages erected upon them, and the ground cultivated with root-crops and wheat or oats, spending the produce on the land; but the more general plan has been to carry away the produce to the high land, which system was very successful for many years after the enclosure, owing to the great fertility of the soil, abounding with vegetable matter; but it has now become very exhausted, and presents a foul and weak appearance.

Borough Fen is the property of Sir Cullen Eardley Eardley, and is a very fine tract of rich land, containing some first-rate grazing pastures, capable of feeding one beast to the acre during the summer months. The arable land is principally cultivated after the following system: 1, Coleseed, mangel-wurzel, carrots, or potatoes; 2, Oats; 3, Seeds; 4, Wheat; 5, Winter beans; 6, Wheat; this may be considered the present system since the introduction of winter beans, previous to which the following course was adopted: 1, Coleseed or root crops; 2, Oats; 3, Wheat; 4, Seeds; 5, Wheat.

The beasts kept are bought in during the autumn, and put into the yards to consume the straw, receiving 6 lbs. of oilcake per head, and some mangold or carrots daily. The sheep are the Lincoln breed, being purchased as tegs in the spring, grazed and made off fat during the summer, or kept on to coleseed. I saw some very fine shear-hogs on Mr. Thomas Griffin's farm weighing 40 lbs. per quarter.

The land is farmed in a very superior manner, but there is a great want of farm-buildings. Most of the houses are comfortable residences, but the provision for the accommodation of cattle is not in unison with the size of the farms, most of them exceeding 400 acres.

Sir Cullen Eardley Eardley has erected school-rooms on the estate; a great number of children from all parts of the fens attend the schools, many coming from Crowland, a distance of 4 miles.

The four principal occupiers are Messrs. John and Thomas Griffin, Mr. Pank, and Mr. Virgette; they are all large consumers of oilcake, grazing and feeding about 100 beasts each annually, besides giving cake to sheep. In the consumption of cake they consider that two-thirds of its cost lies in the manure, and one-third is returned on the beasts in beef; and that two-thirds of the cake given to sheep is returned in the shape of mutton.

Horses.

There are not many horses bred in the county, probably not more than sufficient to supply the annual wants of the farmer in

the keeping up of his team. There has been a great improvement in the kind of horses used for the purposes of agriculture. The old, heavy, slow-moving, hairy-legged animals have been replaced by more light, active, and useful ones.

The light soils are ploughed with two horses abreast, but the treading of the land by the near horse is found injurious on the mixed and heavy land, and three horses in length are used on these farms. On the more tenacious soils, when receiving its first furrow, four are often used, and you may sometimes see five horses in length attached to a plough. I should think one at least is sent out to exercise. When more than three are employed a great amount of power is lost by the animals being at so great a distance from the plough. Scarifying is generally done with four or six horses, placed two abreast; harrowing is done with one, two, or three horses, according to the state of the land and weight of the harrows.

The soiling of cart-horses during the summer is very general; for this purpose a regular supply of rye, clover, winter and spring tares is provided and taken into the yard; by this system a large quantity of good manure is made, and the team kept off the pasture-land. During the winter and spring months they are kept in the stable or yard on clover, hay, cut chaff, and straw; receiving, when at constant work, a daily supply of corn. About four horses to the occupation of 100 acres is the proportion usually kept; where the land requires extra labour, and a considerable part of it to be done quickly, extra horses will be needed.

Few blood horses and nags are bred, and good useful hackneys are scarce and command high prices.

The principal fairs for the sale of horses are Fotheringay, Oundle, Rowell, and Boughton Green fairs.

Implements.

They are very numerous, and it will only be necessary to refer to the principal ones, beginning with the plough, as the primary one in agricultural occupations. There are various patterns used in different localities, most of them made of cast and wrought-iron, and with wheels.

The principal makers in this county are Ball, of Rowell, who took the prize for the two last years in succession at the Royal Agricultural Society's Show; Adams, of Cotton End; Cooch, of Harleston; Kembell, of Wellingborough; Stanley, of Peterborough; and many are made up by wheelwrights and blacksmiths in different localities, varying in their castings.

The old swing wooden ploughs, without wheels, are still manufactured at Woodford, near Thrapstone, a village long noted for

that kind of plough. There are also a considerable quantity from Ransomes, Howard, Pearson, Sanders and Williams, and other distant makers, used throughout the county.

In consequence of an improved system of husbandry, repeated ploughings on land in a high state of cultivation have become less necessary, and the scarifier or scuffler supersedes the plough at some seasons of the year. Mr. Knight of Northampton, and the Messrs. Smiths of Northampton, Kettering, and Stamford, make some very strong and serviceable wrought-iron scarifiers; Finlayson, Ransome, and other makers have some in use in several parts of the county; and many scufflers are made with wood-beams and iron-shares by local manufacturers.

Drills are used very extensively. The greater part of them are kept by men who let them out to hire, sending a man with them, performing the work at from 1*s.* 3*d.* to 1*s.* 6*d.* per acre; but it is of great advantage to a farmer to have a drill of his own on the spot. Many days are often lost in waiting for the drill-man to come, and a favourable fine day frequently is lost by the drill being previously engaged by a more fortunate neighbour. I once lost considerably by being just one day too late in drilling a field of barley: wet weather set in, and that part of the field that was drilled in early, on a dry tillage, *was more productive by two quarters per acre than the remainder of the field*, which was deferred for two or three weeks in consequence of the weather being unfavourable. *It taught me a lesson, and the next year I purchased a Suffolk drill.*

The drills used are principally "Steerage drills," the man following behind and directing the drill. They are made principally at the iron foundries in Northampton, and by other makers in the county; Messrs. Brettells, of Northampton, have made some very good ones. There are not many Suffolk drills used.

Thrashing machines are also let out to hire, worked with four horses, and will thrash from 20 to 30 quarters per day. Steam power has also been brought to bear upon this part of agricultural labour, and steam-engines now perform the work of horses. These are also let out for hire with a stoker and feeder, thrashing the corn at from 1*s.* to 1*s.* 6*d.* per quarter—the farmer finding a supply of coal and men to assist. When the barn is commodious a large quantity of corn may be speedily thrashed, but they are not adapted for small, confined barns, and are more frequently used out of doors, with sheets for the reception of the corn. A few steam-engines for thrashing and other general purposes of the farm have been of late years erected, but not to any great extent. The late Sir Thomas Cartwright erected one on his commodious farm-buildings at Aynhoe; J. Beasley, Esq. has one now at work on his farm premises at Overstone; and Sir Charles Isham,

at Lamport, has also a portable engine, made by Hornsby of Lincolnshire; Sir Charles employs it also in the sawing up of timber on his estate.

The most approved winnowing-machines are those made by Mr. Cooch of Harleston, who took a prize at the Northampton Meeting of the Royal Agricultural Society in 1847. He has also invented a very novel machine, called the "Barley Hummeller," for the purpose of breaking off the horns of the barley when being dressed. Mr. Blackwell, of Twywell, has also been a very noted winnowing-machine maker for many years, and there are a great number of his manufacture in use. Some small occupiers still separate the chaff from the corn by the fan—a very slow and tedious process. Chaff and turnip-cutters are very much used: Gardner's turnip-cutter seems to maintain its superiority. The manufacturers of chaff-cutters are too numerous to make a selection. Horse-power is often attached to a chaff-cutting machine; narrow-wheel waggons, broad-wheel dung-carts, and one-horse Scotch carts are in general use.

Many of the modern implements seem to have called forth the ingenuity of the makers, but are not always adapted to put into the untutored hands of the agricultural labourer; and many a farmer has the mortification of seeing a very nice piece of machinery broken or rendered useless by the neglect, inattention, or want of skill of his servant. Strength and durability are not always sufficiently taken into consideration with many implements for daily use in the cultivation of the soil.

Manures.

The principal supply of manure is produced from the farm-yard, and when well made and applied to the land in a proper state, is the most durable and beneficial kind of manure, and maintains its superiority over any other artificial dressing. On the first-rate farms cultivated on the four-course system, a very regular supply of manure is made by keeping the cattle on hay, clover, corn, and turnips—thereby converting the straw into manure. These farms are thus kept in good condition without any outlay for artificial compounds. On the generality of farms a constant and liberal supply of this necessary commodity for good farming is very difficult to obtain, and recourse is had to every expedient within reach to increase the quantity and improve the quality of the manure heap. The cleaning up from the sides of hedges, and the scourings out of ditches, with road scrapings, are carted together, and either deposited at the bottom of the farm-yard or manure-heap. Cattle are fed on corn and oilcake; sheep have a liberal supply of corn and turnips; pigs are fattened, and very little straw is consumed by cattle, but is used for

litter;—these and many other plans are adopted by the farmers of this county in order to increase the supply of manure.

Great difference of opinion and diversity of practice exist amongst practical men with regard to the management and application of manure; some prefer carting it out from the yard or stalls to the dunghill, there to lie some time together, and ferment and decompose before it is applied to the land; others take it direct from the yard in an unfermented state on to the land; or if the land is not ready for its application, and they wish to remove it to the field, it is carted over very firmly to prevent fermentation, and covered over with earth. It is generally found that "rotten dung," as it is called, acts the most speedily; but it is urged that by letting it ferment and decompose before its application a considerable part of its soluble and valuable qualities are thereby lost, and that an earlier application, although not so immediate in its effects, is permanently more advantageous.

Farm-yard manure is generally applied to the green and root crops on the light soils. On the stiff soils, when they are dead fallowed for wheat, the sheepfold is applied, and an addition of manure to complete what may not have been folded. When beans are planted previous to a crop of wheat, the manure is applied to the bean crop, thereby assisting the growth of the beans and rendering the land in good condition for the succeeding wheat crop. In the autumn, should there be a surplus of manure after the fallow-crops have been manured, it is either applied to the clover-ley, or to the land intended for winter tares, or rye. The latter plan is very advantageous on light land; it facilitates the growth of the tares; and when consumed, the decomposed manure will render the land in good condition for a crop of white turnips, or, to use a county phrase, "the land will plough up in good heart." It is not very customary to apply manure as a top dressing on the young seeds, although it might be attended with considerable advantage; the principal reason for not doing so arises from the fact that clover seeds invariably follow the white grain crop immediately succeeding the fallow: the land, therefore, is considered in condition to support the plant. On some land in high condition, where the barley crop is frequently bulky, causing the seeds to be thin and weak, it might be more politic to bestow rather less manure on the barley crop, and apply some portion as a top-dressing to the young seeds, for it is found that a thin crop of clover is generally the precursor to a light crop of wheat.

Sheep-folding on bare land is still practised to some extent; the fold being fresh set every night, or else made larger, and the sheep put in two nights in succession. It is not done on the best kind of land capable of feeding sheep, it being considered that the

deterioration of the animal exceeds the value of the manure. Fold-yards during the winter months are becoming more general; being kept well littered with straw, and the sheep supplied with hay or chaff, a considerable quantity of manure is made. Folding on the clover seeds during the summer months is often resorted to, the sheep having a daily supply of corn.

Lime, which can hardly be called manure, is often considered such, and is applied in some localities on the fallow land. I do not think the general use of it has increased of late years. Many farmers who used to apply it to their turnip soils have altogether abandoned it; and on the stiff arable land it is not used extensively. Its operation is most successful on woodland or peaty soils, abounding with vegetable matter. It is burnt in all parts of the county, the greatest quantity at Kingsthorpe.

A system of claying the red stony land has been adopted by Messrs. David and John Gaudern, on their very excellently cultivated farm at Earl's Barton. Their plan has been to dig out a clay-pit on the lower part of their farm, and to cart the blue clay on to the turnip fallow in the winter months, leaving it on the surface to be pulverised by the frost, and to be mixed with the surface soil. They speak very satisfactorily of the result, both as regards the return for the expense incurred and the improvement of the land. Mr. Kimbell has also adopted a similar plan in the parish of Irthlingborough.

Burnt ashes are occasionally used as manure, being drilled in with the turnip seed. In some districts, paring and burning the surface soil, and spreading the ashes on the surface, has been adopted. When this system has been applied to old worn-out pasture land, by being "breast-ploughed" the land has afterwards grown great crops of corn for several years without any extra manure.

Woollen rags, soot, pigeon and hen-roost dung, and other light dressings, are used, but the limited supply of these kinds of manures prevents their being extensively used.

It would be almost impossible to enumerate the many portable manures, of a light and artificial kind, continually being presented to the public. Those mostly used in this county are guano, rape-cake, nitrate of soda, superphosphate of lime, bones, and salt, which are nearly exclusively applied to the turnip crop.

Liquid manure is not used to any considerable extent, very few homesteads having the means of preserving it by tanks.

On the Management of the Grass Land.

The grass land of the county may be divided into three kinds; viz.—1, meadow land, irrigated with water; 2, rich pasture or feeding land; 3, second-rate and inferior grass land.

1. *Meadow Land, flooded by Streams.*—The valleys of the rivers Nene and Welland, and the smaller rivers and brooks running throughout the county, supply a very considerable tract of fertile meadow land, which receives very little attention from the occupier. During the winter months no stock is permitted to tread or poach the land, owing to its wet state, and it is not very often stocked in the spring, excepting for a few weeks in the months of March or April, after which it is shut up for mowing. After the hay is carried, the aftermath affords good pasturage during the latter part of the summer, and in dry seasons up to November or December.

Meadows that are regularly flooded do not require any manure, but those that are only partially irrigated often have a slight dressing in the autumn or early in the spring, or they are occasionally grazed, or mown and grazed alternately.

The irrigation of the land is very arbitrary and accidental, owing to the water-mills possessing the entire control over the stream, and in the summer months great loss is often incurred by the land being flooded and the hay injured. Considerable damage is also done by the water stagnating on the surface, and not getting back into the river, owing to the land being lower than the bank of the river, and there being no back drainage to take it away; meadows so situated grow a coarse and inferior description of grass. Water-trenching and keeping the ditches open form the chief part of the work done on the land. Mr. Underwood, of Hardingstone, has improved a large meadow in his occupation by underground drainage.

The meadow land is generally divided in every parish between the several farms, and supplies the principal part of the hay crop. In the vicinity of the market-towns meadows are let separately to innkeepers and others, with liberty to sell or take off the hay; and they command a rental from 3*l.* to 4*l.* per acre.

2. *Rich Pasture or Feeding Land.*—Scattered throughout the several parts of the county will be found small plots and fields of first-rate feeding land; but the districts leading from Fawsley (the seat of Sir Charles Knightley) and Daventry to Northampton, and from Northampton in the direction of Maidwell, Haselbeach, Clipstone, and Market Harborough, form the greater part of this land; but considerable portions will be found in a line of country extending from Daventry in the direction of Watford, East and West Haddon, Winwick, Thornby, Elkington, and Welford, on the several estates of Lord Henley, H. B. Sawbridge, Esq., Sir J. Langham, and Earl Spencer; also in the northern part of the county, on the estates of the Duke of Buccleuch, Lord Overstone, W. B. Stopford, Esq., and Lord Lilford; in

each of these districts there are several grazing farms of feeding land, with but a small proportion of arable.

Small inclosures of this land adjoining a homestead or village are often mown for hay, and have a dressing of manure every two or three years, or are grazed and mown alternately; but where the land is occupied for the feeding of beasts it is not mown, but kept in a continual system of grazing, and does not receive much attention from the occupier. Spreading the manure made by beasts, or, to use a provincial phrase, " knocking the clots"—mowing the thistles, *which are often very abundant*—and keeping the fences in condition—these, with a light attention to the drainage, form the principal manual labour employed on rich grazing land.

The stock kept are principally feeding beasts, turned into the pastures in the month of May, and sold off fat the latter part of the summer. About 2 acres of land are generally allowed to each beast, and a few sheep are also kept with them, consisting of wether tegs, or ewes and lambs, which are to be sold off fat during the summer.

In the autumn, when the feeding beasts are gone off fat, either the whole or part of the next year's stock is purchased and turned on the land to eat the " rough knawing" up to Christmas, when they are put into the strawyard, or they remain on the land, receiving a supply of hay until the ensuing May. But few sheep are kept when beasts are grazed, they being found to prevent the rapid feeding of neat cattle when lying too thick in the same pasture. It is always a great point with the grazier to get his beasts to market as early as he can, thereby being enabled to obtain a better price, and to get them off the land.

3. *Second-rate and inferior Grass Land.*—This is the character of the principal part of the grass land in the county, and it is spread very uniformly throughout its entire length and breadth, varying in quality in different localities, and often on the same farm. A considerable portion of the second-rate land will be found in connexion with the rich grazing districts before mentioned, and in the northern and southern extremities of the county. The woodland and wet districts of Rockingham, Salcey, and Whittlewood forests supply the greatest part of the inferior grass land.

Land of the above quality comprises the dairy-farms and sheep-walks, from which the sheep are frequently folded during the summer on to the arable land. The following is the general system pursued in the management of a dairy-farm.

A certain number of calves are reared every year, which receive some new milk for the first two or three weeks; they are then reduced to skim milk, boiled daily for them, with an allowance of good hay. They are kept on the farm until three years

old; the steers are then sold to the grazier, and the heifers are put into the dairy stock, to supply the place of the cows annually sold off, either barren or down calving. When calves are not reared they are sold at a fortnight old, or made fat for the butcher, and the dairy herd is kept up by the annual purchase of heifers or cows, to supply the place of those sold out. About a third or fourth part of the grass land is mown every year—unless there is some meadow land connected with the occupation—which gets occasionally a slight dressing of compost dung. A flock of sheep is kept, and the lambs are sold at Michaelmas. Thus a great quantity of the annual produce goes off the land without a corresponding return, and the land degenerates by this treatment and becomes weak and mossy.

Very little cheese is made in this county; the making of it is chiefly confined to the side of the county adjoining Warwickshire and Leicestershire. It is taken to Daventry and Harborough cheese fairs for sale.

The produce of the butter from the dairy districts around Brackley, Daventry, and Stony Stratford is principally sent to London. In the northern part, and in the interior of the county, the butter is forwarded to the nearest market-town, Northampton receiving the largest supply, and being also the great mart for poultry and eggs.

A considerable breadth of this land is occupied in connexion with arable land, but it is injured if the stock be repeatedly folded away from it on the arable land, without a corresponding return; but when the proportion of grass land is small in comparison to the arable, it is often much improved by having some of the produce of the arable land spent upon it. It is highly probable that the inferior grass land might be greatly benefited by drainage, and a more generous treatment; but the return being very slow, and the annual produce so scanty that few tenants are disposed to make the outlay, the several proprietors have not been forward in the improvement of this part of their property; both parties alike seem to have employed their energies and capital in the improvement of the arable land, while the poor thin grass land has been suffered to drag out a profitless existence, and to become less productive.

Hay-making forms the principal work requiring extra labour on grass land. The great art of securing the hay crop is to get it together sufficiently dry to prevent injury from over-heating or moulding, and yet not to expose it so long to the drying influence of the sun as to cause its most nutritious qualities to evaporate. When rain falls on hay nearly fit to cart to the stack great injury is done to it, both with regard to its colour and quality. Large occupiers use hay-making machines to break and spread the grass,

but more frequently the labour is performed by men and women. When the hay has been exposed to the weather for some time, and has lost its natural smell and colour, salt is spread in layers in the stack at the time of carting ; cattle will then eat it better, and it is considered to be improved. Rick-cloths, with pulleys and poles, are occasionally used for protection during the time of making the hay-rick.

Grass land is principally manured with a compost made of the scourings of ditches, road-scrapings, with a portion of lime or farmyard manure. The dung of cattle is also by many persons collected together and spread over the land. Nitrate of soda, soot, and other light dressings, are also applied. When rain falls soon after the application of nitrate of soda the effects are speedily visible in the dark green hue of the grass. Water-meadows, irrigation by artificial means, are not much practised. The late Adam Corrie, Esq., tried it very successfully on a meadow in the parish of Wellingborough, but rendered himself liable to an action at law, and had to pay damages to the proprietor of an adjoining mill, who brought an action for interfering with the mill-stream. It was formerly adopted in some meadows belonging to Earl Spencer at Chapel Brampton, but is now abandoned, upon the plea that the quality of the grass was rendered coarse and inferior. The late C. Tibbits, Esq., of Barton Seagrave, carried it out in that parish, but I understand his successor has not persevered in the plan.

Many grass-fields lie in ridge and furrow-lands, and remain in the same state as when they were sown down at the time of the enclosure of the parishes, with the headlands and furlongs still very prominent. The meadows and lowlands which have never been ploughed lie more even. It must be admitted that throughout this county very little attention and labour are expended upon the grass-land ; meadows suffer from the stagnant water being permitted year after year to stand on the surface during the winter months ; repeated crops of hay are taken off without any return ; our rich pastures are too frequently overrun with thistles, nettles, and hassocks, and a considerable breadth of them rendered unfit for winter pasturage, owing to the want of drainage. The second-rate grass-land and inferior pastures are not being improved, mole-hills are suffered to accumulate, rushes and moss occupy the surface instead of herbage, and the land yields a very small produce to the occupier. This description of grass-land has not enriched the tenant nor improved the rental ; it has done but little towards causing a greater demand for labour, and has not contributed much annual increase of produce to supply the wants of the community. *The law of progress has not reached the broad acres of our cold wet pasture-land.*

Cattle.

The oxen fed on the rich pasture-land, or grazing districts, are generally bought in, being principally purchased at the different fairs, or at Northampton Weekly Stock Market, either in autumn or spring, and made fat during the summer. The principal breeds are the Herefords, Devon, Shropshire, and North Wales beast, with Scots, Irish, and home-bred steers.

The breed of cattle peculiar to the district is the "Short Horn," and the county has many breeders of this kind worthy of notice. The Duke of Buccleuch, the Marquis of Exeter, the late Marquis of Northampton, the late and present Earls Spencer, Lord Southampton, Sir C. Knightley, Sir Capell Brooke, Rev. Sir Geo. Robinson, John Beasley, Esq., Messrs. Manning and Faulkner, of Rothersthorpe, and many other gentlemen have for many years devoted their attention to the improvement of this breed, and taken prizes at the different Agricultural Societies in the locality. A very superior herd was sold last November at Aynhoe, the property of the late Sir Thomas Cartwright, which commanded high prices. Sir Charles Knightley and Mr. Manning have also had annual sales of surplus stock, producing very satisfactory prices; the former last year had a bull-calf which made over 100 guineas, and this year his sale of 12 bull-calves averaged about 40 guineas per head.

In the dairy districts short-horned cows are the most prevailing kind of milking beasts kept. There are very few of the old long-horned cows now bred or used, but there are, however, a great variety of cross-breeds of a most medley character scattered throughout the county, some of them partaking of the Alderney, Welsh, Irish, and Hereford's cross-breeding; and although very deficient in form and aptitude for feeding, still are useful milkers. When calves are reared, considerable attention is paid to the breed of the bull kept, and also to the colour of the calves, red and roan being found the most saleable and favourite colours. Some land proprietors have kept on their own farms a well-bred bull for the use of their tenantry. I remember, seven years ago, going to Sir Robert Gunning's farm, at Horton, to see a very superior bull that had been purchased in Yorkshire, and which was for the use of his tenantry in that locality; and upon going over the same property this winter I saw many good herds of home-reared stock on the tenants' farms.

Stall feeding, as a regular system, is not practised very extensively. The great object of the grazier is to get his beasts fat at grass. When it is practised it is more from necessity than choice, arising from the beasts not being quite fat in the autumn; they are therefore put into the stalls and receive some hay, oil-cake, or

corn, for a few months, until they are fit for the butcher. The late Clark Hillyard, Esq., of Thorpelands, was a considerable stall-feeder of beasts.

Box-feeding has not been adopted to any great extent, owing to the want of accommodation, all newly-erected bullock-hovels having been made with stalls for cattle. It has been carried out to some extent by Mr. Wallis, of Rowell Lodge, Mr. Webster, of Peakirk, and a few others.

Annual sales of fat cattle by auction have been practised by many large feeders of cattle of late years, amongst whom may be mentioned Stafford O'Brien, Esq., who farms very largely at Blatherwycke; J. Beasley, Esq., at Overstone; Messrs. Cave and Wright, of Grendon; and Messrs. Mathers, of Irchester.

Many farmers, having suitable occupations, breed and feed their own short-horned cattle, raising their stock from the dairy, rearing them up upon the inferior grass-land, and fattening them on their rich pasture-land.

Considerable loss has been incurred of late years from the pleuro-pneumonia epidemic. In some cases as many as 20 or 30 dairy cows have died of it on one farm. The first symptom of the disorder is a cough, with expectoration of a thick mucous secretion. The animal loses flesh and appetite, experiences great difficulty of breathing, and gradually becomes weaker and weaker. It very much resembles the disease called consumption in the human frame, and seems, like that, to baffle and defy all medical skill. Loss is also incurred by cows dropping after calving, especially in the summer months, when they are in high condition. Bleeding a few weeks before they are expected to calve is a very safe precaution.

Last autumn an effort was made to form a Mutual Cattle Assurance Company in the vicinity of Northampton, but it was not successful from the want of support; there is one formed at Banbury, which numbers many of the farmers on that side of Northamptonshire among its supporters.

Sheep.

The Leicester breed may be justly considered to form the greater part of the flocks of the county. The principal breeders of rams of the Leicester or Bakewell breeds are, Earl Spencer, Mr. Hewitt, of Dodford, Mr. Earl, of Barton, Mr. Freestone, of Irthlingborough, Mr. Wallis, of Barton Seagrave, and Mr. Valentine Barford, of Foscote. The latter gentleman has been following out a system of in-and-in breeding for the last 40 years, without artificial food, and may be considered to have one of the purest breeding flocks, direct from the lineage of Mr. Bakewell, of any in the kingdom.

On the Oxfordshire side of the county, the Leicester flocks have been crossed to some extent with the "New Oxfords." These are sheep of large dimensions, and are bred in Oxfordshire and the surrounding districts. A cross of this kind increases the size and weight of the Leicesters. The Cotswold or Gloucestershire rams are also used in the county, principally those bred by Messrs. Lyne and Cother, from the celebrated flock of Mr. Hewer. They very much resemble the "New Oxfords," and, like them, have a tendency to increase the size of the flock.

Towards the northern extremity of the county, adjoining Lincolnshire and Leicestershire, the Leicester flocks have received a cross by the introduction of the "Long-woolled Lincolns." A very large show of these rams are brought for sale or hire to Peterborough Michaelmas fair, by Messrs. Price, of Risborough, Kirkham, of Hagneby, Hodgkin, and Clarke, and many other Lincoln breeders. The advantages of this cross are principally in the increase of wool and size, but they require good pasture-land to prepare them for the butcher.

On the turnip soils in the interior of the county, and on the side adjoining Buckinghamshire and Bedfordshire, a cross with a southdown has become the most prevailing system—the advantage being a hardier constitution, finer texture of wool, and a superior quality of mutton. Sheep of this cross will generally produce 4*d.* per stone (of 8 lbs.) extra in Smithfield, which is of considerable importance to the grazier for the London markets. The wool also will command a higher price. It may be questioned if they possess the same aptitude to fatten as the Leicester, the more active and restless habits of the down sheep being undoubtedly imbibed by the cross. Mr. Jonas Webb and Mr. Ellman have both sent down rams into this county.

It requires much skill and judgment in the proper management of breeding from repeated crossing, and many persons have had their flocks materially injured by looking more to the size of the male animal than to its other equally important qualifications, viz., strength of constitution and aptitude to fatten. The crossing of pure breeds of sheep has generally been considered very beneficial, especially the first cross; but there exists some difference of opinion with regard to future proceedings, as to the propriety of putting the crosses together. Some of the most perfect and valuable animals have been produced by the first cross, and none more so than a cross between a pure bred down and Leicester. Mr. Twitchell, of Wilby, has shown some very superior sheep of this cross which took the prize at the Northampton Show last summer. He also took the prize for sheep of the same breed at the Birmingham Christmas Show.

Respect should be had, in the breeding of sheep, to the nature

of the soil on which they are fed, for such is the effect of soil and situation, that when animals have been taken from a poor district and put upon a richer pasture, they soon increase both in the size and substance of their progeny; and animals that have been on rich land, and taken from thence to a poor common, lose both size and condition: hence arises the common saying in this county, "That a great part of the breed goes in at the mouth." Welsh sheep are kept on some poor wet grass-land, but not to any considerable extent; in some gentlemen's parks a few are kept for the table.

When fat lambs are reared, the Leicester ewes are often crossed with a western or horned ram. Mr. Watts, of Scaldwell, and Mr. Sherman, of Milton, are the two principal breeders of rams of this breed. Lambs of this cross are of quick growth, and soon fit for market. There are also many of the half-bred down lambs sold off during the summer.

The ewes are put to the ram about the first week in October; ewes for fat lambs about a fortnight earlier. The usual mode is to turn the ram loose amongst 60 or 80 ewes, and to draw them out as they take the ram, to be followed by an inferior one. When the ewes have been with the ram about six or eight weeks, they are generally put on some old grass-land until Christmas, after which they receive some hay, turnips, or oats, up to the lambing season; the ewe and her produce then run together until June or July, when the lambs are weaned on aftermath or clover-seeds, and the ewes are either folded or put to inferior keep, after being culled over by taking the old ones out, either to be made fat, or sold for raising fat lambs another year.

The system of sheep-dipping for the destruction of ticks is generally adopted by many farmers in the autumn: a solution of corrosive sublimate, sulphur, and soft soap being used. When the lambs are not dipped, many persons give them a slight dressing with mercurial ointment, for the same purpose, previous to their being put to turnips.

Sheep are generally shorn in May and June, commencing first with the fat sheep and lamb-hogs, leaving the ewes until last. I have not heard of lambs being shorn in this county, although it is practised in some parts of the kingdom. There is an annual wool-fair held in July at Northampton, and a considerable business is done; buyers coming from Yorkshire and Leicestershire, in addition to the local woolstaplers.

The diseases of sheep are very various: dysentery, red water, and inflammation of the lungs are the most fatal. Owing to an improved drainage and more attention being paid to the food, the ravages of the rot have of late years been much reduced; this also applies to those banes of the flock the foot-rot and scab.

Pigs.

The rearing and feeding of pigs is carried on by most farmers to some extent, the most prevailing breed being the Berkshire spotted pigs, these making the largest and best bacon; they are sometimes crossed with the Suffolk breed, which have smaller and lighter bones and finer flesh, but they do not come to so great a weight when fat as the Berkshire breed, yet are more saleable to the butcher, and feed more rapidly. The more delicate and fancy breeds of the Neapolitan and China are not kept to any extent by the farmers, but principally for the table of gentlemen's families; the objection to them in the straw-yard is, that they are too tender for general use, and not so prolific. Porkers from 5 to 6 score in weight are regularly fed, in the dairy districts, on peas and skim milk, and forwarded to the London market or sold at home. Bacon-pigs run in the straw-yard for the summer, and in the fields during the season of stubble and acorn-keeping, after which they are put into the stye and fed on barley-meal and millers' offals; they range from 10 to 12 score when fat. When breeding sows are not kept, pigs are generally bought in from two to three months old, and sold out again from the straw-yard as stores, or kept on to fatten.

The large Berkshire hogs are great consumers of food; a stag hog,* lately killed at Towcester, having been fed by Mr. Meads, of Floore, consumed from the 1st day of June to the 31st day of December, 1850, 40 bushels of barley-meal, 6 bushels of beans, 8 bushels of peas, 2 cwt. of pollards, 2 tons of mangold boiled, and 6 quarters of potatoes, and weighed, when killed, 32 score.

On the present state of the Farm Buildings throughout the County, and their adaptation to an improved system of Husbandry.

Throughout the entire county will be found some very good and convenient farm homesteads, but they may be considered the exception, and not the general rule. On the Duke of Grafton's estate are some of the largest, he having, some years ago, remodelled some parts of his estate, and erected a considerable quantity of new buildings. Lord Overstone and Lewis Lloyd, Esq., have a very fine estate, having been large purchasers of land for several years, and have erected and repaired nearly all their farm buildings. The Marquis of Northampton, Earl Spencer, Lord Southampton, Sir Robert Gunning, E. Bouverie, Esq., Sir A. Brooke, Sir John Palmer, and many other proprietors have been making considerable improvements to their farm buildings on their several estates.

In many parts of the county are several "lodge farms," many

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* A castrated boar pig.

of them the property of the occupier, who has erected some convenient outbuildings, to which is attached a comfortable residence; some of them may be ranked among the most commodious and pleasant occupations in the county, being often situated on the side or top of a hill, and commanding a wide and beautiful prospect. Some of them are capable of further improvement by the addition of more accommodation for cattle; and the erection of a few labourers' cottages on the farm would also be a great advantage.

While we would willingly yield our meed of praise to noblemen and other land proprietors who have, during the last few years, been making great efforts to improve their farm buildings, yet very much still remains to be done, and there is a great want of proper accommodation for the cultivation of the soil. In some villages you will not see a good farm-homestead; the houses are low, with small barns and stabling, ill-contrived yards, with miserable accommodation for cattle and pigs; all the buildings covered with thatch, and often very dilapidated, thus entailing an annual demand for straw on the tenant, which is not very often granted, until a high wind or the roof taking wet, renders it absolutely necessary to commence operations. In many cases these forlorn buildings are all the provision for the cultivation of 150 to 200 acres of land, probably the greater part arable. It is in vain for the tenant to endeavour to improve the quality of his manure by stall-feeding cattle, for he has no bullock-hovels; or to expend corn or cake in the yard, for the first heavy rain that falls washes all the soluble parts of the manure into the horse-pond, which is an invariable appendage to a Northamptonshire old-fashioned farm-yard.

In some districts you will find many good, substantial, well-built, stone farm-houses, a good barn, but the other buildings very inferior; this shows that while attention has been paid to the dwelling-house and a suitable provision for the thrashing of the corn, yet no great attention has been paid to the yard, or accommodation for a supply of that commodity to replenish the barn—viz., a good supply of well-made manure, forgetting that every improvement in the cultivation of the soil necessarily brings with it a requirement for increased accommodation to convert the produce of the farm into manure.

In many parishes the whole of the farm-homesteads are situated in the village, and the land lying out behind them; or, in some instances, in different parts of the field, and at a considerable distance. I have known the produce drawn as far as two miles to the homestead. The inconvenience which the occupier must labour under from residing at so great a distance from his land, and the loss of time and extra expense in cultivation, in carting

the produce home, and again carting the manure back, is very great. This position is partially remedied, in some instances, by the erection of a field-barn and yard, with a cottage for a labourer, but they are often very deficient in suitable accommodation for cattle; the only provision, in many cases, being limited to arrangements for the thrashing of the corn and stabling for a team of horses, with a yard and shelter-hovels. Where no field-barns are erected, the cattle are permitted to remain on the grass-land during the winter, receiving a daily supply of straw or hay, and seeking shelter under the highest hedge; a very considerable quantity of manure is thereby comparatively lost, for the cattle generally come to the warmest and driest spot to be foddered, at which point in the field the manure accumulates, and the ground becomes much trodden. Very few farms have suitable buildings for the lambing of the ewes, but are obliged annually to erect a sheep-fold, or, as it is provincially called, a "sheep hirk," with stubble, or hurdles stuffed with straw, for an outer wall; these are often very exposed and badly sheltered places for a flock of ewes and lambs during the bleak and cutting storms of March and April.

It would be invidious to mention names, but it must be admitted that in some grazing districts requiring but little manual labour, a system of depopulation has been very systematically carried on by the proprietors for several years. Cottages and farm premises have been pulled down, and no new buildings erected; the land has been let out in large quantities to non-resident occupiers, and the only buildings are a few cow-houses or shelter-hovels, scattered over the different farms. This system has not been strictly confined to grazing districts, for many arable farmers in small parishes have to seek a supply of labourers from adjacent villages. The desire to relieve the estate from parochial rates has been the principal cause for this line of conduct, and it has been successful on that point; but it has left the estate without a supply of labourers, and thereby lessened its value to the occupier. I was much struck with the following very sensible remarks on this subject made by a north-country farmer, at the discussion on the law of settlement, at the "London Farmers' Club." He stated, "that a north-country farmer would as little think of hiring a farm without comfortable and contiguous cottage accommodation as if it was devoid of stabling or shed-room for his animals. We know better," said he, "than to buy labour in an *exhausted condition*, which must necessarily be the case where the man has four or five miles to walk night and morning; besides, if they were located on my farm, I can attend to their little wants, and we are, by being so situated, almost one family, and I find myself trebly repaid by their attention to

my interests and the care bestowed on both my live and dead stock." Similar remarks to these were made at an agricultural meeting in this county by A. Pell, Esq., of Hasselbeech, who stated the inconvenience he daily experienced in the cultivation of a farm he had lately taken in this county from the want of a supply of labourers. The roads throughout the county are generally good, owing to the liberal supply of stone and gravel for repairing them; but some occupations are very inconvenient from the want of a good road, and a considerable wear and tear is incurred in the drawing of the produce from the farm to an adjoining road. Great improvements might speedily be effected by the co-operation of the landlord and tenant, good materials often being at hand, if not upon the farm. The wet clay and back woodland farms suffer the most from the want of good roads, and in wet weather, during the winter, owing to the treading of cattle, their dwellings are hardly approachable. I am glad to be able to record that a spirit of improvement has commenced in many parts of the county with regard to farm-buildings. Landlords who have been contented with letting their property without suitable accommodation, have commenced a better system; and I am willing to hope that those proprietors who have neglected this part of their property will imitate those who are carrying on a steady and visible annual improvement. Very few counties possess within their own limits so many facilities for the erection of buildings as this; on many estates will be found good beds of clay suitable for brick-making; lime-stone may be dug for the erection of walls, and for a supply of lime. Sand is also abundant, timber is at hand, and throughout the length and breadth of the county will be found great natural resources of the raw material, only requiring the skill of the workman and the capital of the proprietor to convert the same into good accommodation for man and beast.

Labourers and Cottage Allotments.

No class of the community has shared so much in public sympathy as the agricultural labourer. Societies have been formed for his aid, and many encouragements given by landed proprietors, and others, to promote his advancement in the scale of society, but he still is not placed in a very fortunate position, and is often called upon to suffer many privations from the want of employment. A life of patient toil, with the prospect of ending his days on parish relief, seems to be the common lot of the farm labourer.

In the central part of the county, where the villages are small and the land good and well cultivated, the labourers may be con-

sidered to be the best off, and to have more regular work at higher wages.

Previous to the late reduction in the prices of agricultural produce, the rate of day wages to an able-bodied labourer was from 10*s.* to 12*s.* per week, with extra wages for hay and harvest time. They are now reduced to from 8*s.* to 10*s.*, which is paid in money, generally every week, many farmers paying on the Friday, to give the labourers the advantage of having Saturday to make their weekly purchases. Small beer is given at the rate of one quart per day, and ale during hay and harvest, and for extra work. Boys for driving plough get from 2*s.* 6*d.* to 4*s.* per week. The wages of young men, hired to live in the house as horsekeepers or shepherds, vary from 6*l.* to 12*l.* per year, according to age and ability. Lads for milking get from 3*l.* to 5*l.* yearly. When labourers work at piece-work, they generally earn a higher rate of wages per day.

The new poor-law has tended to lessen the parochial rates, and to reduce the amount of "surplus labour." About 15 or 20 years ago there would be, during the winter months, in large populous villages, from 30 to 40 men and their families maintained in comparative idleness from the poor-rate; but now the knowledge that an able-bodied man in health is not to be relieved out of the workhouse causes all men of this class to be desirous of keeping and securing a constant place of work. It also leads the farmer to make some regular provision for the employment of his labourers during the winter months, yet, notwithstanding this "new system" has thus acted both on the minds of the employed and the employer, still it does not cure the evil. Every winter we see with regret young active men seeking employment and finding none; and I believe that it is to this oft-repeated want of employment that we may trace much of that petty pilfering so common in our rural districts.

Very laudable and praiseworthy efforts are made by the resident clergy and gentry to encourage and facilitate by all possible means the employment of the poor, and various local societies are formed for the encouragement of provident and careful habits, by the establishment of clothing, medical, and coal clubs, and other kindred institutions, to which the poor contribute weekly, having, in addition, the contributions of the honorary members at the end of the year equally divided amongst them. The Rev. F. Litchfield, of Farthinghoe, takes a deep interest in the formation of clothing clubs, and has a large and flourishing one in the parish where he resides.

To the credit of the labouring men it must be stated, that they maintain and support out of their scanty earnings a number of provident or sick benefit clubs, and although these are often badly

managed, the landlord of the public-house where they are held getting some share of the contributions, still they are very excellent institutions, and often cheer and support the family when the head of it is laid low upon a bed of sickness or of death.

The dwellings of the agricultural labourers are very diversified in their style, size, and accommodation; some of them being built with mud and plaster, very low, having dirt or stone floors, and covered with thatch; others are built with stone or brick, but very small, and thatched; one room on the ground-floor, with a pantry under the stairs, and one room above, are all the accommodation which many of them contain, for the parents and a family of children. In some of the larger villages, where the land is good, and the materials for building nigh at hand, there are some very good comfortable cottages, with two rooms below and two above; but the greater part of the abodes of the farm-labourers throughout the county are in a neglected state. It would be well if more attention was paid to this part of our rural economy, because the comfort, cleanliness, and decency of the cottage of the working man is of considerable importance in the formation of the character of his children. One great barrier to the improvement of them arises from many of the cottages being nominally the property of the occupier. The labourers having been permitted to run up mud cottages on the waste ground, upon paying an annual quitrent to the lord of the manor, become very tenacious of any interference, and upon the principle of an "Englishman's house being his castle," bid defiance to all sanitary measures of improvement. Others again are freeholds, legally belonging to the occupier, but who is frequently saddled with the yearly payment of interest to the mortgagee, equal probably to its annual value, and he therefore cannot keep the property in tenantable repair, still he clings with fondness to the "home of his fathers," and wishes to die there, providing the "old house" will last as long as his own "clayey tenement."

There has been a considerable emigration from the populous rural villages during the last few years. Several hundreds of labourers with their families have been forwarded to the different colonies. It has been adopted to lessen the pressure upon the poor-rates, caused by a superabundant population; but I do not feel at liberty to go further into the question, considering it is not the design of this Report to enter too deeply into the domestic economy of the agricultural labourer; my business is more to give evidence of facts than to state opinions of my own; still I would suggest, that one of the remedies for the present want of employment consists in a higher and more profitable cultivation of the soil, thereby producing a greater demand for the labour of the working man.

Cottage allotments are very general, scarcely a parish without a field being apportioned for that purpose; many of them are on the glebe farms, or are the property of a resident proprietor. They are let out in plots of from 20 to 40 poles each, at rents varying from 3*s*. to 6*s*. per pole, and are much prized by the labourers, who grow upon them potatoes and other vegetables. They are often inconveniently situated, lying at a distance from the labourer's dwelling; they sometimes produce unpleasant feelings on the part of his master, in consequence of the man occasionally taking leave to give over work somewhat earlier to work at the "lotment," and men have been known to go to their own land before coming to their work on the farm. It would be of considerable advantage, if, in the erection of new cottages, a rood or 20 poles of garden ground were allotted to it; under such circumstances, the wife and junior members of the family might assist in the cultivation of the garden, and the labourer himself might of a summer's evening be more inclined to have an hour in the garden after a day's toil, than when he has to walk a mile to the allotment field. The extension of cottage allotments has been tried in some parishes by the letting out of 2 or 3 acres to the better class of labourers, but it has not succeeded, and has been nearly abandoned. Few men had time and capital at command to work it properly, and many of them proved to be shocking bad farmers.

The Rev. C. Smith, of Weston-cum-Weedon, has carried out spade cultivation very satisfactorily on about 4 acres of land in his own occupation and under his own immediate attention. I had the pleasure of going over his land and seeing his system of management. He double digs the soil, and plants 3 rows of wheat 10 inches asunder, then leaves a space of 36 inches, and so on through the piece; having one half of the land wheat, and the other half exposed to the influence of the atmosphere during the summer, which last is planted with wheat the succeeding year, when the wheat stubble is dug up, and rested in turn. He has pursued this system on 1 acre out of the 4 for four successive years, and has grown on the average 34 bushels of wheat per acre each year, without any manure. So sanguine is he of success, that he has this autumn taken in hand 4 acres more of the vicarage farm, has placed the rent at 60*s*. per acre, and intends to follow out the same system, and hopes to show a good profit. He cultivates root-crops upon the same principle, to which he applies all the manure he makes, and by combining the system of deep cultivation with the extirpation of all weeds, he grows some splendid specimens of mangold and swedes. He may be thought enthusiastic on this subject, still he is worthy of attention. He considers his system would not be successful on all soils.

On many noblemen's estates the cottages are let very low, the

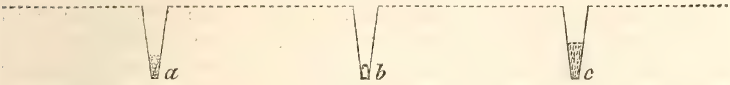
rent being from 5*s*. to 20*s*. per year, and the tenants are expected to keep them in a tenantable state of repair; this in too many cases they neglect to do, and the property falls into decay. When the cottages are the property of private individuals they are built for investment, and command a higher rental, varying from 2*l*. to 4*l*. per year, the owner doing the repairs. Earl Spencer has of late years been very much improving the cottages on his estate; Lord Overstone has also erected some model ones at Abingdon, Lord Southampton has much improved the village of Whittlebury; and many other resident landed proprietors have been led to take active steps to improve the dwellings of the agricultural labourers, but in some districts they still present a forlorn and dilapidated appearance.

On the Mode and Extent of Drainage done throughout the County.

During the last 20 years a very considerable proportion of the heavy arable land has been "furrow-drained;" this has been done with tiles, stone, blackthorn wood, or straw. The work is executed by digging the drains up the furrow, between the lands, from 20 to 30 inches deep, into which the materials used have been placed, as in drawing A. This kind of draining not lasting many years, the work has been again repeated, and in some districts of heavy wet land, draining is a regular employment every winter, on some parts of a farm. On the wet grass-land, draining has been done to a more limited extent; in some cases the work has been executed by head drains being laid at the end or head of the lands, and the furrows drained with a draining plough, drawn by 4 or 6 horses, cutting a small groove through the turf, penetrating into the soil from 18 to 20 inches, and forming a cavity below the surface, with a share, formed like a sugar-loaf. The Rev. T. Tryon, of Bulwick, has adopted this plan with advantage for some years past on the rectory farm, and he informed me that he has a plough with which he can execute from 8 to 10 acres of furrow-draining in a day. Turf-draining is the plan mostly adopted. The turf is taken off the top, and a drain dug out about 30 inches deep, the last spit or draw being much narrower than the preceding one, thereby forming a shoulder on which the turf is laid, as in drawing B *a*, or the system of wedge-draining is pursued by a drain being cut out, and contracted angularly to a very narrow bottom, a grass-sod is then cut from the turf in the form of a wedge, the grass side being the narrowest. The sods are then placed in the drain, the grass side undermost, and pressed down tightly as far as they will go, thereby leaving a cavity, forming a regular drain, as in drawing B *b*. Of these the wedge-system is decidedly the best, and when

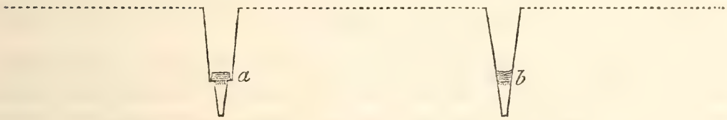
executed with sound turf will last many years. Prizes are given every year by the Northamptonshire Farming and Grazing Society for this kind of draining; also for pipe tile-draining; and last year at Broughton, near Kettering, there were some very excellent specimens of draining work.

A.—*Furrow Drains,* 24 *inches deep.*



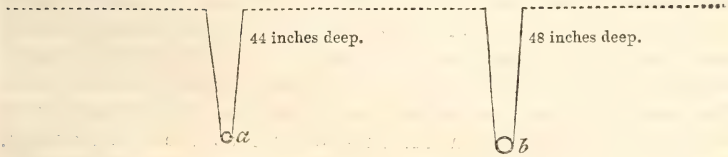
a. Stones. *b.* Tiles with flat bottoms. *c.* Blackthorn wood.

B.—*Turf Drains,* 36 *inches deep.*



a. Turf laid on a shoulder. *b.* Wedge draining.

C.—*Pipe Tile Drains.*



a. Small tiles. *b.* Larger tiles for main drains.

The red and sandy soils have a natural drainage by reason of the porous nature of the subsoil; yet there too draining is sometimes needed to cut off the spring-water, which is often found running along a stratum from 6 to 12 feet below the surface, and, in consequence of meeting with obstruction in its course from a bed of clay—frequently on the side of a hill—rises near to or runs over the surface, and, from its extreme coldness and continued flow, becomes very injurious to vegetation. In order to cure the evil, care is required that the drains should be of sufficient depth, and in the proper position, for catching the supply of water. In some localities there are small plots of boggy ground completely saturated by the rising of the water to the surface; from the loose and soft nature of the subsoil it is often very difficult to drain, and it can only be done successfully by the drain cutting off the supply. J. Boughton Leigh, Esq., who has lately been farming part of his estate at Guilsborough, last year drained a bog of this

description, but it was a very expensive affair; the drains were obliged to be about 16 feet deep. John Smith, Esq., of Thornby Grange, has erected some new farm-buildings, the site of which previously was a complete bog. He commenced by drainage, and succeeded in cutting off the supply of water, which he now applies, by the aid of a water-wheel, to the purposes of thrashing his corn and cutting chaff with considerable success.

The most durable drains now in existence are made with stone. Main-drains are now running freely that have been laid from twenty to thirty years; they are generally formed by stones placed in the following forms, V Λ, at the bottom of the drain, over which broken stones are placed, thus forming a safe and durable drain. When used to furrow-drain arable land, they are either put in edgeways, or they are broken small, and the lowest chad or spit is filled with them, on the top of which is placed some straw.

Draining-tiles, in this form ∩, have been used extensively, and form a good channel for water; but when used without soles they have been liable to sink into the ground and become blocked up. They are now superseded by the circular pipes.

In woodland districts, where blackthorn wood can be readily and cheaply obtained, it is used very extensively for furrow-draining. The thorns are put in either tied up in small bundles or loose at the bottom of the drain, and trodden in very closely previous to the drain being filled in. Where the subsoil consists of a stiff clay they will last for some years, leaving a cavity after the wood has become decomposed; but on sharp gravelly or sandy subsoils the drain becomes useless as the wood decays. Stubble-straw alone has been used for draining, but this practice has entirely ceased; when used, it was either twisted tightly together, in the form of a rope, or compressed closely at the bottom of the drain.

During the last seven years a new system, which may be designated "Mr. Parkes's plan of drainage," has been carried out to a considerable extent in many parts of the county; a very similar system having previously been followed by the Hon. C. Arbuthnot, on a large farm in his own occupation at Woodford. He then departed from the general system of "high lands" and "furrow-draining," by laying the drains according to the natural fall for the water, and levelling the surface of the land.

In the years 1846 and 1847 much draining was done on the estate of Lord Pomfret: a pipe-tile yard was erected, and a very considerable part of the estate in the parishes of Towcester, Easton Neston, and Shuttlehanger, was drained. The drains were cut 11 yards apart and 4 feet deep, and a percentage was charged to the tenants upon the amount expended. The work

was very successful on the greater part of the estate, but in some cases it did not secure a complete drainage. In the month of January last I rode over one of the farms in company with Mr. Wm. Higgins of Northampton, for the purpose of valuing the acts of husbandry between the outgoing and incoming tenant, and we both noticed that for about 3 yards on each side of the drains it was sound riding, but when we got about 5 yards from the drain the water stood upon the surface, and our horses sank in fetlock deep. Had the drains been 6 or 8 yards asunder, it would have been a more successful drainage. During the last two years his lordship has not done any drainage, but has given tiles to his tenantry, they doing the labour.

At the present time Lord Southampton is very much improving an estate that he purchased of the Duke of Buckingham, comprising the parishes of Astwell and Faulcott, having from 100 to 120 men draining. The work is done upon the principle recommended by Mr. Parkes, viz. 4 feet deep, but the intervals are varied according to the nature of the subsoil. The drains run in parallel lines, either across or up the furlong into main drains, laid out according to the natural fall; the ditches are deeply dug out, to give a speedy transit for the water to flow away. The pipes used vary, according to the length of drainage, from 2 to 5 or 6 inches in diameter. After the land is thus drained the "lands" are got down by the summer fallow, and the rain falling on an even surface percolates through the soil into the drains. His lordship has also erected some new buildings, and will in a few years materially improve and increase the produce of the estate.

Some few years ago the late Marquis of Northampton had some part of his estate at Castle Ashby drained on the plan recommended by Mr. Smith of Deanston. The materials used were broken stones, placed about 9 inches deep at the bottom of the drains, which were cut 3 feet deep and 6 yards apart; it was found to answer very well, but in consequence of the expense of carting and breaking the stones pipes are now used, which his lordship supplies to his tenantry at the kiln, they performing the labour. The pipes furnished are 2-inch bore, with larger sizes for the main drains. His farm bailiff, Mr. John Robinson, informed me, that on the land in his own occupation the tiles are put in from 3 feet to 3 feet 6 inches in depth, and from 5 to 6 yards apart, and the lands laid up a little round in the centre; the furrows ploughed out and trenched across the headland, to facilitate the water getting away more freely after heavy rain.

Lord Lilford, who owns a very fine estate, extending about four miles on both sides of the turnpike-road leading from Thrapstone to Oundle, commencing at Titchmarsh, pays one-third of the

amount expended in tiles and labour by his tenantry. A great part of the estate has been furrow-drained, but a considerable portion requires to be drained again, from the old drains being worn out.

On the estate of Wm. Hope, Esq., at Rushton, considerable draining has been done, at the depth of 2 feet 6 inches to 3 feet, and from 7 to 10 yards apart; the proprietor charging five per cent. upon the outlay. Mr. B. S. Pulver informed me that he and two other tenants last year used 300,000 tiles on their farms, and that they should use as many this year. The Duke of Cleveland has obtained a grant from the Government Fund, part of which has been expended in draining the Duke's property at Brigstock, charging 6½ per cent. on the outlay. The Right Hon. Vernon Smith has a tile-yard at the same place, and does the drainage at 5 per cent. on the outlay. The tenants are also permitted to have tiles, they doing the labour. Stafford O'Brien, Esq., of Blatherwycke Hall, who farms upwards of 1000 acres of heavy land, has a tile-yard and makes his own tiles, and has been draining both deep and extensively. Around that vicinity, which is all heavy land, a considerable quantity of draining has been executed; also in the vicinity of Rockingham, Great and Little Oakby, Weekly, Warkton, Grafton, and Geddington; some of the proprietors executing the work and charging interest, others finding tiles and the tenants cartage and labour.

Considerable draining has also been done by Lord Ellesmere, near to Brackley, J. B. Leigh, Esq., at Guilsborough, Sir Charles Knightley at Fawsley, Sir Charles Wake at Courtenhall, Sir Robert Gunning at Horton, and many other proprietors throughout the county.

On the large estates of the Duke of Buccleuch, Duke of Grafton, Earl Spencer, Lord Overstone, and Lewis Lloyd, Esq., tiles are given, and the tenants are doing the labour. This plan is more popular with the tenantry than where the proprietors do the entire work and charge a percentage on the amount expended. It affords the occupier the opportunity of having the work done at his own convenience, under his own control, and according to his own plan of draining. When tiles are given care should be taken that the work is done properly, some persons being unwilling to incur the expense of putting them deep into the ground.

With regard to the best mode of executing pipe-tile draining there exists much difference of opinion amongst practical men, and both experience and observation are daily teaching us that *no general rule can be safely laid down for the proper depth and distances of drains.* A system which would prove eminently successful on a stratum of porous subsoil, might become a partial failure on a more retentive stratum of clay or marl; hence has

arisen in some minds a degree of prejudice against what may be called "draining-works" on large estates. One uniform system, both with regard to the distance apart and depth of the drains, has been followed, apparently without any regard to the nature of the soil and subsoil; consequently, some portions of the estate so drained have been greatly improved, while on the other parts, if it has not been an entire failure, it has not succeeded in effecting the end desired. It is very evident that the depth of each drain should be regulated by the nature of the subsoil; and that the distance from one drain to another should be arranged with a view to effect the complete drainage of the interval between each drain, the design of draining being to assist the stiff soils, by artificial means, in obtaining that necessary and permanent dryness so suitably presented to us on the dry and turnip soils of this county; and the nearer we make the mechanical condition of the clay soils approach this standard the more perfect will be our state of cultivation.

Draining with pipe-tiles being a very modern invention, there has not been at present sufficient time elapsed to form an opinion of its durability. Whenever the work has been well executed it has answered very successfully for the speedy conveyance of the water from the soil, and has proved that much labour and expense have been thrown away in the shallow drainage of that land which requires a deeper system in order to effect a complete drainage of the land.

The greatest proportion of undrained land in the county consists of inferior pasture land, with some portions of thin neglected arable land, lying wide for occupation, often by the side of woods, and liable to be injured by game, the strict preservation of which in some parts of the northern division of the county has operated to the injury of the crops, and has been a great barrier to the proper cultivation of the soil. In all those districts where I found the tenantry complaining of game I also saw a state of inferior cultivation, and an indifference to the growth of root crops. So long as land proprietors are strict game-preservers they must pay the penalty in a neglected estate, and an inferior class of tenantry; *very few men will farm with energy and spirit when their crops are overrun with game, and overhung with timber trees.*

On the Improvements made in the County since the Report of Mr. William Pitt, in the year 1806.

Donaldson, who preceded Mr. Pitt, in 1794, does not give a very favourable view of this county; nor does Mr. Pitt's report, which seems to have been very candid, present a much higher standard of cultivation. In making a comparison between its present and past state I shall not have the advantage of the reporters

of some other counties. I cannot tell of "blowing sands" being converted into fine arable farms, and brought into a state to call forth alike the envy and the admiration of the country. We have no large tracts of fen-lands made, by drainage and cultivation, the most productive and profitable soils; nor can I record that "wolds and bogs," by the skill of the cultivator, have lost their former wanton appearance, and have become sound convertible land. But I have some few matters of marked and visible improvements to state, and although these may not be so numerous or so satisfactory as one might desire, still I hope to be able to show that the labour of nearly half a century has not been thrown entirely away.

Probably the greatest improvement has taken place on the light turnip soils. Mr. Pitt writes of some of them in his report as follows:—

"Northampton, towards Boughton, land enclosed and light; turnips and rye grown; furze preserved; on stronger land cabbages grown, several acres. At Kingsthorpe and Moulton observed this day several fields of potatoes and rye turning colour for ripening."—p. 304.

"Harleston Heath is enclosed, but only partly cultivated."—p. 106.

"Rye is pretty much cultivated here, particularly in the vicinity of Northampton, and upon light land."—p. 93.

"On the red soils of Glendon Mr. Coleman's course on the best land is—1. Oats; 2. Wheat; 3. Turnips; 4. Barley, with seeds, and three years at grass. On weaker land—1. Oats; 2. Pease; 3. Turnips; 4. Barley, with seeds, and at grass three years. No wheat grown on this soil."—p. 78.

"Rothwell, common field, and neighbourhood is a light turnip-soil, and turnips are grown upon it on an extensive scale. Upon all these light tracts of land a considerable quantity of rye is also produced."—p. 9.

The reader will perceive from the above extracts that they apply very generally to a greater part of the light red land districts, and at the time the report was written those were considered unfit for the growth of wheat, and consequently of less value; and in all the old valuations of land for parochial assessments the heavy wheat and bean land was invariably assessed at 6*s*. to 8*s*. per acre higher than the light soils. Previous to the inclosure these parts of the open fields were generally much neglected, suffered to remain as sheep-walks, or were covered with heath and furze bushes; and in the several apportionments of land to the different proprietors at the time of the inclosure the light red land of the field was reckoned of the least value. I recollect having been informed by the late Mr. Warren, farmer of Earl's Barton, who occupied a farm in the parish of Irthlingborough, and frequently rode over the open field of Finedon, that the two farms now in the occupation of Mr. William Johnson and Mr. Bayes were then overrun with furze, and a very small portion ploughed. These are now two of the best cultivated farms in the parish, having convenient lodge-homesteads; and,

under a superior system of management, they yield a large annual produce. At the time of the inclosure the one now belonging to Mr. W. Johnson was apportioned to a shrewd Scotch banker, whose instructions to the Commissioners were, to place him on the worse side of the field, and to give him a good extent of acreage. His request was granted: he commenced building a good homestead, and the property has since that period doubled in value.

Many such instances might be given of the increased value of this land on each side of the road leading from Northampton to Highgate House, passing through the parishes of Kingsthorpe, Boughton, Brampton, Spratton, and Creaton. Similar land is also found in the parishes of Harleston, Dallington, Duston, Moulton, Pitsford, and adjoining parishes. A district of land formerly sown with rye instead of wheat has now become one of the most fertile and best farmed in the county. The extension of the turnip system has produced a supply of food for sheep, which, being consumed on the land, has supplied manure for the barley crop; the land being then sown with seeds, and grazed, has given both strength and solidity to the ground for the succeeding crop of wheat.

Another tract of the same land, alike improved by a similar mode of treatment, extends from Northampton in the direction of Abingdon, Weston, Billing, Ecton, and Earl's Barton; at Wilby the soil changes and becomes more tenacious, but gets lighter at Wellingborough, running in the direction of Finedon and Irthlingborough. This is naturally a richer soil than the former districts, having more depth of staple, and less sand. It grows fine crops of corn, and is well farmed.

Mr. Pitt has inserted (p. 66-7) the amount of stock kept in the parish of Rothwell previous to the inclosure, as follows:—

Horses, estimated	120
Cattle, number actually kept . . .	360
Sheep, ditto	1920

I should consider that at the present time the horses kept will be about the same number; but the cattle may be estimated at 500, and the sheep 3000. If the same estimate were to be made (and I think it might justly be made) with regard to all the other parishes which have been inclosed during the last forty-five years, the result would show a large increase of stock kept.

There has also been some improvement in the better cultivation of the heavy land, and the extension of a better system of drainage. Mr. Pitt refers to some districts which since the time he made his report have been greatly improved. At page 300 he writes as follows:—

"Blisworth has a common field on a grey stonebrash loam; the crops much

infested with weeds. Stoke Bruen has a waste, or common, never yet enclosed or cultivated.

"From Welford, through Naseby, the open field extensive, and in as backward a state as it could be in Charles I.'s time, when the fatal battle was fought. The lowest part a rough moist pasture, with furze, rushes, and fern abounding. The rest a strong, brown, deep loam, in the usual bean and wheat culture. This parish is as much in a state of Nature as anything I have seen in the county."—p. 304.

These extracts relating to heavy land will show that at the time Mr. Pitt wrote those parishes were in a very neglected state. Blisworth is now inclosed, and divided into farms of from 150 to 250 acres, and lodge farm homesteads have been erected on them. Stoke Plain is now inclosed, and two large homesteads erected. The land is much improved, particularly one farm of 400 acres, which has been occupied for some years past by Mr. W. Dunkley, but not finding the land yield a profitable return for the capital expended upon it, he has lately given up the occupation. Naseby field has since the inclosure been much improved, and is now a useful corn growing parish. The heavy land system of cultivation has been made more productive throughout the county. The old system of laying the lands up high and trenching out the furrows was not attended with much success; it rendered a yard on each side the furrow nearly unproductive by reason of an excess of moisture, and it was no uncommon sight to see the water standing halfway up the sides of the land after heavy rain. Under the system of furrow-draining the furrows have become as productive as the ridges; it has also enabled the occupier to grow a greater variety of crops, and the "dead fallow" has been superseded by the growth of green crops.

The converting of old worn-out pasture land into arable has been attended with considerable success where it has been fairly carried out. In some instances, by successive crops of white grain, without any return of manure, this land has only been changed from poor grass into impoverished arable land; but, under a more liberal treatment, it may be ranked amongst the improvements. It has been done with advantage in the parishes of Elkington and Yelvertoft, under the superior management of Mr. Joseph Elkins, a tenant of Earl Spencer's. I had the pleasure of going over some of his land last harvest, and saw a very splendid crop of oats carting from a field that I recollect in my boyhood as very poor grass land, and in which I have often bounded from ant-hill to ant-hill after the peewits, which are found to frequent inferior pastures. Mr. Barringer, of Chapel Brampton, has also been successfully adopting the same plan; and in another part of the same nobleman's estate, in the parish of Strixton, some of the roughest and most unproductive pasture land has been converted, by the skill and enterprise of his lord-

ship's tenantry in that locality, into very useful and productive corn-producing land. On the estates of Lord Overstone, Lewis Lloyd, Esq., J. Hope, Esq., E. Bouverie, Esq., and many other proprietors, similar results have followed, but the extent of this kind of improvement has been very limited.

It would be a fruitless attempt to endeavour to condense into this report a tithe of the improvements that have been effected by mechanical skill in the manufacturing of agricultural implements during the last forty-five years; I shall therefore only refer to a few, commencing with the plough. I have myself held many times, in the once open fields of Stanwick, one of those old-fashioned one-handled ploughs, the right handle not being fixed, but consisting of a staff with a hook at the end of it, supplying the double office of handle and plough spud. This was abolished for the Woodford swing plough, "which still is an useful implement for the stirring of rough fallows;" after which Ransome's and other wheel-ploughs were introduced. I remember when Mr. Turnell, of Dallington, who at that time was occupying a large farm at Stanwick, introduced the wheel-ploughs on his farm, that it produced quite a consternation amongst the ploughmen and boys; loud and frequent were the prophecies that they would never do, but they have outlived all their predictions, and we have now at our different annual ploughing matches as good specimens of ploughing as can be done in any of the adjoining counties.

The thrashing and winnowing machines are both new inventions; the former has to some extent displaced the flail, and the latter the fan. Crosskill's clod-crushers have superseded the "wooden beetle," or spiked roll; the drill takes the place of the seblet; and in every kind of agricultural implements, the mechanical skill of the different makers has been called into active enterprise.

There has also been a very great improvement in the breeding of cattle and sheep. The old long-horned cows have been replaced by the improved short horns, and this county is much indebted to the late Earl Spencer, "of whose worth the county may be justly proud," for the untiring energy, liberality, and practical knowledge, he evinced for many years in the improvement of the breeds of cattle and sheep. The success of the Northamptonshire Farming and Grazing Society was, from its commencement, much indebted to him and the late Clark Hillyard, Esq., of Thorpelands; and it is to be regretted that since his death it has not been carried forward by the tenant farmers with that vigour and support it deserves. The present Earl Spencer liberally contributes to its funds, and it ranks amongst its supporters the names of the Duke of Buccleuch, Marquis of Exeter, Sir A. Brooke, Rev. Sir

Geo. Robinson, Bart., J. H. Stopford, Esq., Colonel Cartwright, and many other large breeders of cattle and sheep. It holds an annual meeting alternately at Northampton and Kettering for the distribution of prizes for stock; it also holds ploughing, sheep-shearing, draining, and hedge-cutting meetings, for competition for prizes. There is an Agricultural Society for the encouragement of good ploughing, shepherding, length of servitude, &c. &c., at Wellingborough and at Thrapstone; also another at Peterborough, which has an annual show of cattle and sheep. Earl Fitzwilliam liberally contributes to the Peterborough Society.

About twelve years ago an Agricultural Book Club was formed at Northampton, for the purpose of holding monthly meetings for discussions on agricultural subjects, and for the institution of a library. It numbers about 100 members, some of whom subscribe to sweepstakes for the best crops of mangold, turnips, and other root-crops.

The excessive preservation of game has of late years in some parts of the county been much mitigated, and this must be considered a great improvement. Rabbits have been kept down, and the quantity of hares considerably reduced; a better feeling has existed between landlord and tenant on the subject — the former not wishing to keep game to the injury of his tenant, and the latter not wishing to interfere with the amusements and recreations of his landlord. In some districts there still exists room for further improvement in this respect.

There is but little taste in this county for experimental farming. I am not aware that we have any "model farm" in the county, yet we have many tenant-farmers cultivating their occupations in first-rate style. Several large landed proprietors have land in their own occupation, managed by farm bailiffs; they are too numerous to refer to them all, but I may mention the Duke of Buccleuch, at Boughton House; Marquis of Northampton, at Castle Ashby; Earl Spencer, at Chapel Brampton; Lord Southampton, at Whittlebury; Earl Cardigan, at Dean; Lord Carberry, at Laxton; Rev. Sir Geo. Robinson, at Cranford; Sir A. Brooke, at Geddington; Sir John Palmer, at Carlton; Sir Charles Wake, at Courtenhall; Sir Charles Knightley, at Fawsley; J. Neville, Esq., at Walcutt; and Stafford O'Brien, Esq., at Blatherwycke, as occupying farms on which no expense is spared in their cultivation.

The farms throughout the county are not very large, seldom exceeding 400 acres, the greater number varying from 100 to 250 acres. When persons have larger holdings, they consist chiefly of 2 or 3 farms lying contiguous, or situated in different parishes. Mr. James Hobson, of Barton Seagrave, is one of the largest tenant-farmers, occupying farms in the several parishes of

Barton Seagrave, Kettering, Isham, and "Withmale Park Farm" in the parish of Orlingbury. The occupiers of farms of about 200 acres and upwards are generally men of capital, and there are many wealthy freeholders who farm their own estates. The tenants of small farms of 50 or 60 acres are men of small capital, and assist in performing the work of the farm; they are a very industrious class of men, but do not rank much higher in the scale of society than the farm-labourer. Where the occupation is below 30 or 40 acres, the occupier generally follows some other business in connexion with his land, or else is a dairyman selling milk, occupying grass-land in the vicinity of a town or large village.

The rent of land in this county varies according to its quality. The inferior and second-rate farms range from 20*s*. to 30*s*. per acre; and the better land averages from 30*s*. to 50*s*. per acre. Accommodation land in the vicinity of towns commands a higher rental. Where the vicar has not had an apportionment of land in lieu of tithes, they are generally commuted into a rent-charge, varying from 4*s*. to 7*s*. per acre. Poor-rates are regulated by the size of the parishes from 1*s*. to 6*s*. per acre, exclusive of highway and church-rates.

On the Improvements still required throughout the County.

Having before entered at some length "On the present state of the Farm Buildings," I need refer to them again only to remark that the present provision of buildings is quite inadequate to the wants of our improved system of husbandry, and calls for a decided and active movement on the part of the proprietors to supply the deficiency.

No doubt many proprietors are alarmed at the expense of erecting entire new premises, and those who have the means are often at a loss to know what plan to pursue, so great is the difference of opinion as to the proper arrangements for stock and farm produce. But without going to an extravagant outlay of capital, very great improvements and additions might be made to many of the present farm homesteads. The building of an extra barn, the enlargement of existing cow-hovels and stabling, or the simple addition of a new yard, might convert a now inconvenient homestead to a more useful and profitable one. It must be admitted that some are so bad as to be past all cure. A steward of one of the largest estates in this county being called upon to give an opinion of some existing farm premises, said, in reply—"I am often puzzled to know, in the revision of farm buildings, what to retain and what to remove, but in this case, I have no doubt, the only plan to pursue is to pull them all down."

In addition to a suitable arrangement for stock and the other purposes of husbandry, there should be a dwelling-house suitable

to the size of the occupation. It is not necessary that it should be a costly building, but it should be made comfortable and convenient; for if the tenant of 200 or 300 acres of land has the required capital, skill, and enterprise for its proper cultivation, surely there is a fitness in his residence being appropriate to his situation in life, and there is no absolute necessity for such a man to hide his head in a hovel.

Improvements of this kind, although much required, must of necessity be a work of time. Many proprietors have not the means at command, and others have not the inclination to meddle with bricks and mortar; but in the mean time much may be done by the tenantry being assisted with rough timber, and other building materials, by the landlord, for the extension and improvement of their present accommodation, as it is admitted by all men practically acquainted with farming operations, that a good convenient homestead is indispensable for the proper and profitable cultivation of the soil.

There requires an improvement in the tenure of land, in order to give greater security for the capital invested by the tenant. Nearly all the occupations of land in this county are held upon a yearly tenure—very few leases are granted. An attorney in this county informed me that having been in practice amongst a rural population for thirty years, he did not remember being called upon to draw out a lease for a farm.

Most of the farms are either Michaelmas or Lady-day holdings, terminating at the 10th of October or 5th of April, and some being regulated by the 29th of September and 25th of March.

Many farms are held under no regular agreement, but are guided by the "custom of the county," which is not very definite with regard to the cultivation of the land, and allows considerable latitude in the growth of corn crops. It includes in its general meaning that the tenant is to keep all gates, stiles, and outbuildings in tenantable repair. The proprietor to find rough timber and building materials; all hay, straw, and root-crops to be consumed on the land, and converted into manure, which is to be the property of the landlord. At the expiration of a Michaelmas tenancy the out-going tenant is to be paid for working the preceding summer fallows, and to be allowed one year's rent, rates, and taxes on the same, and for the seeds and turnips sown; and to be allowed the use of the barn and yard until the next Lady-day, or the 1st of May (as agreed upon), for the purpose of threshing the corn and spending the straw. When the tenancy expires at Lady-day the outgoing tenant is to be paid for the growing crops of wheat, for the winter ploughing, for the young seeds, and is allowed the use of the yard until May or June, to spend any remaining straw. Under this custom no compensation

is given for any draining done on the farm during the tenancy, or for any permanent improvements done by him previous to his giving up possession; but if the tenant can be proved to have overcropped the land, or neglected to cultivate it properly, or in any way to have injured the freehold, he is liable to pay compensation for all dilapidations.

Many tenants hold under agreements differing very much in the covenants: in some a regular system of cropping is marked out, and a departure therefrom is visited with heavy penalties; grass land is forbidden to be converted into tillage. The right of the game is reserved to the landlord or his nominee; fences to be cut regularly, and certain proportions of the farm drained yearly; and, in addition, many other clauses and technical phrases are inserted, which, if ever read, are totally disregarded; and it may safely be said that such agreements are more generally broken than kept. I know a case where a man signed an agreement to grow a fourth part of his farm turnips and cabbages, and during seven years of his occupation never grew any.

In some agreements the only covenants relating to cultivation are simply to prevent the growth of two white crops in succession, and the tenant is at perfect liberty to follow whatever other rotation of cropping he may choose. Compensation is also given for draining done during the last three years of the occupation—the landlord retaining the right to the manure.

From the fact of the greater part of the land in this county being in the hands of noblemen and resident country gentlemen there is great security of tenure. The entire tenantry of one of the largest land proprietors averages nearly 100 years each of family occupations, and many tenants can trace back for several generations the occupancy of the same farm. This system applies to the tenantry of all the nobility, and may account for the small number of leases. The late Earl Spencer offered his tenants leases, but only one of his numerous tenantry accepted his offer.

Among the smaller proprietors there are more frequent changes of tenants, and consequently less security of tenure. In some cases considerable loss has been incurred by parties laying out their capital in improving the farm and then being called upon to leave it—the landlord obtaining from the next tenant an increased rental from the improved condition of the land, without being called upon to make any compensation to the outgoing tenant. I know a case where the rent was raised from 30*s.* to 42*s.* per acre, owing to the great improvements effected in draining and improving a farm, all done by the tenant, and towards which the proprietor did not contribute a shilling, nor make any compensation to the outgoing tenant. I am happy to say that such cases in this county do not often occur, but truthfulness

demands a faithful admission that there have been such cases; nevertheless, I firmly believe that the delicate and mutual relations of landlord and tenant are as honourably carried on in this county as in any other part of the kingdom. The colleges of Oxford, and the dean and chapter of Peterborough, have several large estates in different localities. They are generally let on long leases, renewable every seven years. From the interest in the estate being often dependent upon the lives of the recipients of the rental, very little improvement takes place on such property, and even its cultivation does not always accord with the security of tenure the lessee enjoys. The same principle affects materially the glebe and rectorial farms; they are often destitute of the necessary buildings, and without a residence; are sometimes placed at a high rental, and both the owner and occupier endeavour to get as much off the land for the time being as possible. There are great difficulties in the way of any improvement of the tenure of this description of land, the present incumbent having no inducement to improve an estate which he himself may be called upon quickly to surrender into other hands. Greater facilities have been offered by the Legislature during the last few years to the owners of this kind of property, by the loan of money —to be expended in draining and other improvements—which may become chargeable on the estate, and repaid by yearly instalments.

There exists a very strong feeling in the minds of the tenantry of this county with regard to the present "custom of the country," and a great desire is expressed by them for a more liberal system of "tenant-right." They feel that under a liberal landlord they are as secure of their holdings as if they had a 21 years' lease, but should death or any other circumstance compel a tenant to relinquish his farm, he may be called upon to leave behind him a considerable part of his capital in uncompensated improvements, without any return for the same. A higher system of farming requires that greater latitude should be given to the tenant with regard to the mode of cultivation, leaving him at perfect liberty to follow out the rotation of cropping he may find the most profitable. I have seen many farms on which a great proportion of wheat is annually grown, and yet the land kept in a higher condition, and cleaner state of cultivation, than the adjoining farm, on which the prescribed covenants have been duly kept and a more regular system has been followed, viz. "poor crops and poor farming." It is not by parchment covenants that the landlords will ensure the highest culture of the soil; let them grant security of tenure and liberal covenants, and their tenantry will soon find that good farming is the most profitable in the end. Every person acquainted with agriculture knows full well that if land will not yield a profit by good management it will do still worse by

neglecting it. The farmers of this county who have done the best for themselves and their families have been those who, by a judicious application of their capital to the soil, have received in return an additional profit.

Considerable benefit would be realized to the tenant farmer if more attention was paid to the fences, and by the cutting down of timber-trees in hedge-rows adjoining arable fields. Keeping the hedges on a farm in good order forms no small outlay every year on the best managed arable farms. When free from hedge-row timber, great attention is paid to the fences; they are kept down very low, and regularly clipped every year, and the ditches kept well cleaned out; they give a very neat appearance to the farm, and some districts show a great superiority over others in this department. Many persons object to the topping of hedges during the summer, on account of the thorns getting amongst the hay and corn, thereby liable to injure the hands of the labourers and to lame sheep. In order to remedy this, Mr. J. Webster, of Peakirk, tops his hedges annually, during the last fortnight in May, and again in the last fortnight in July; by pursuing this system he cuts the shoots before they become strong enough to do any injury.

When hedges are not clipped the quicks are permitted to grow from six to eight years; they are then cut and laid down, the wood being used for firewood, or for the erection of temporary fences. Hedging and ditching is done by the chain of 22 yards; prices varying from 1*s.* 6*d.* to 2*s.* 6*d.* per chain, according to the strength of the fence and depth of the ditch to be cleaned out.

The fences round grass land are allowed to attain from ten to twelve years' growth, thereby affording a strong fence and also shelter. In some of the old enclosures the fences are very rough and ragged at the bottom, and are sometimes permitted to run wild, and to occupy a very wide space of ground; and even when not thus neglected they are difficult to keep in good order, being composed principally of different kinds of wood, viz. white and black thorn, maple, hazel, elder, and bramble-bushes; they grow very uneven, and form at best a very miserable looking fence, and the more so from their frequently being both irregular and crooked. When they are united with open gaps and broken gates they give a farm a neglected and slovenly appearance.

The only remedy is the entire stocking up of such old fences, and the replanting of young quicks; but this sort of improvement is much neglected, and some occupiers do not always clean out the ditch when they cut the hedge; the water is thus permitted to stagnate, to the injury of the adjoining land and the young shoots of the fence, as well as blocking up the drainage.

I do not wish to destroy the beauty of my own native county, and should therefore have no objection to see many sturdy oaks left

around our rich pastures, and, notwithstanding all the prejudices against timber-trees, might be inclined to say on some picturesque spots, "Woodman, spare that tree;" still, around all arable fields they should be entirely swept away, root and branch. No one can form an accurate estimate of the injury done by the roots of large ash-trees standing contiguous to a corn-field; and when united with old and irregular fences they encourage mildew, foster couch-grass, and form a regular covert for birds at harvest and seed time. Small enclosed fields, where the divisions are much too numerous, might often be thrown together with advantage to cultivation. Upon going over the parish of Blisworth, I found on Mr. Campion's farm, of 240 acres, as many as 32 different fields, many of them surrounded with spinnies or copses and wood. The farm might be rendered more productive by cutting down the timber and throwing the fields into a more convenient size for occupation, and no outlay would be required by either landlord or tenant in effecting such improvements. The timber and thorns would more than compensate for the labour employed, and which, during the winter months, might be executed at a very low rate. On my own farm, at this season of the year, I have two men stocking up "ash-butts" for the wood, upon condition that I find them a horse and cart to convey the wood to a neighbouring town, about two miles distant, for sale. They get employment with moderate wages, and I get rid of some very "old offenders."

The preservation of timber on many noblemen's estates has been at a very serious loss. I have been informed that on the Duke of Buccleuch's estate trees which were once worth 20*l.* or 30*l.* are become so decayed that they would not now make many more shillings. The same remarks would apply to many other estates in the county; and although it may be urged that timber is preserved not for profit but for ornament, still it seems quite as pleasant a sight for a landlord to see "good crops and a thriving tenantry" as to have his estate overcrowded with "decaying timber-trees."

The converting of some parts of the inferior and second-rate pasture-land into arable is much required in this county.

Many proprietors of these descriptions of land have great objections to their being ploughed up. Large tracts of poor, unproductive grass land in the vicinity of Weston-cum-Weedon, Canon's Ashby, Charwelton, Welford, Kelmaish, Cottesbrooke, Wilbaiston, Brigstock, Rockingham, and in other parts of the county, still remain, yielding little rental to the proprietor, and a very small return of produce to the occupier, in many cases not more than 40*s.* or 50*s.* per acre of gross annual produce, employing very little labour, and, instead of improving in condition, are

in many cases deteriorating in value every year. A wealthy proprietor could not more safely invest his capital than in the erection of suitable homesteads where required; and permitting a considerable proportion of the grass land to be ploughed up, would give an impetus to the industry of the locality and increase the produce of the soil. It would, like many other good examples, soon be followed by others; and districts which now have little to recommend them (save as galloping ground for hunters), would experience a pleasing and beneficial change. It would undoubtedly increase in some degree the responsibilities and duties of the proprietor, but it would be for the benefit of the commonweal, and contribute to supply the wants of an increasing population and the extending requirements of the country. Improvements might be effected on many estates by revising the localities of many farms, in order to render them more convenient for occupation.

Farms are now often ill laid out, occupations intersecting each other, when by the exercise of a little judgment in an exchange between occupiers of fields lying contiguous to each other, holdings might be made much more "ring-fenced." An addition of some grass or meadow-land would be of great advantage to farms having now a small proportion. There exists great disproportion on some large estates, both with regard to the quality of the land on different farms, and also to the extent of accommodation. You will sometimes see one large farm with a small house and buildings; and a large house and homestead allotted to a small farm of 70 or 80 acres. All these revisions should be under the direction of a practical steward, having a knowledge of the different qualities of the land, and able to tell, by personal inspection, not only the condition but also the requirements of every farm on the estate, and who should encourage the tenantry to carry out the most improved system of cultivation, and I have no doubt the tenantry would duly perform their part. We have already sufficient evidence in this county that the best farmed and best managed estates are under the direction of practical stewards, or of gentlemen who take the management of their estates into their own hands; and we have a large number of the latter class who are liberal landlords, and have a respectable tenantry; while those estates that are neglected, or under the direction of men who take no interest in their improvement, are generally the worst farmed and the least productive in the county.

The complete drainage of the valley of the river Nene is essential to a more uniform and effective drainage of the principal part of the county.

The natural great watercourse of the county is the river Nene, which flows through nearly its entire length, being augmented in

its progress by many tributary streams running into it; but the rapid flow of the water is checked in its passage by the flour-mills upon the stream, and by the bed of the river becoming gradually choked up. An improvement is every year becoming more necessary from the increasing extent of draining done on the hills causing a more rapid flow into the valley.

Public attention was called to this subject about two years ago; meetings were held, and a committee was appointed, and reports on the river Nene drainage were drawn up by several gentlemen, from which I have made the following extracts:—

The Rev. C. H. Hartshorne's Report, December, 1848.—" It appears that the meadow land in the valley of the Nene is at all periods liable to be placed under water after a few hours' rain, and that, besides the certainty of an overflow of the river during the winter and autumn, few seasons pass by without a summer flood. On these occurring the loss is most disastrous, since the entire crop of mowing grass, when not cut, is greatly injured by the alluvial deposit, and the hay rendered totally unfit for fodder, if, in fact, it is not swept from the surface by the force of the current. The damage sustained on these occasions is computed at tenfold the loss borne by the occupiers in ordinary seasons.

" Independently, however, of the periodical returns of this calamity in the summer season, which equally baffle all forethought and industrial exertion, the winter floods are an unvarying and certain source of disappointment and loss to the farmer. He is continually driven to pasture his sheep upon the uplands, or else maintain them, before the severity of the weather would necessarily compel him to do so, upon his turnips or artificial food.

" The actual fact of all these beautiful meadows near the Nene bearing no return to the occupier from Michaelmas to Lady-day is, however, universally admitted, and they are regarded merely in the light of half-yearly lands. In the most propitious seasons they are held by him at a loss of 10*s*. per acre, compared to what they would be worth if not liable to these casualties, being one-third subtracted from the value of the land under different conditions, whilst, as has been already intimated, in the common event of a summer's flush of water, his prospects and his exertions are alike hopeless and unavailing, being entirely deprived of every return from this portion of his occupancy, for hay that has once been flooded is not only useless as fodder, but as manure also.

" In illustration of this view of the question, an extensive occupier states that he has only had five months' use of his meadow-land this season, being flooded in the middle of April and in the middle of September. In the month of July a considerable portion of his hay, then ready to carry, was entirely spoiled through an illegal height of water being held up by the mill below, which flowed back upon the land it had once passed through. Independently of this ruin to his crop from causes which will shortly pass under review, he estimates his loss of keep for two or three months, upon 94 acres of land, as sufficient to feed 40 beasts and 300 sheep for the same period. Another intelligent farmer considers the ordinary damage in the parish of Hardingstone, upon 100 acres, as 40*l*. loss to the eating of the crop. Adopting then the former estimate taken in kind, and coupling it with the 8000 acres returned as the lowest number subject to injury, there is an aggregate loss of provender during three months sufficient to support 32,000 beasts and 24,000 sheep. It is more easy to compute the loss, than the benefit which would arise under an amended system of drainage. In business ideas, it is perhaps hardly possible to overrate the importance of having full power over the stream. Providence intended it as a blessing—as a means of fertilizing the soil and filling the earth with plenty; and if man learned how to use it, the water may be made subservient to a benefit equal in amount to the present damage it inflicts."

Report of John Beasley, Esq., December, 1848.—"It is well known that, of the variety of grasses which enrich our best pastures, not one-third will grow or flourish upon land that is constantly wet, but they will spring up spontaneously upon the soils upon which they had never been seen before so soon as it is made comparatively dry by drainage. On the other hand, the inferior grasses, which flourish on wet soils, will disappear and give place to the superior ones when the land is properly drained, in accordance with that beautiful order of Nature which invariably rewards the well-directed labour of man. . . . . The loss sustained by the rot in sheep, for the want of better drainage, though partial, is serious when it occurs. Upon dry soils sheep may generally be grazed with impunity; but upon clay and alluvial soils, in this district they generally imbibe this fatal disease if depastured upon them in a wet season. There are many acres of grass land but little above the present level of the river, unsuited for pasture, which would be greatly improved, and far more profitable, if brought into tillage; but it would be unwise to attempt this, with the chance of the floods and the certainty that they cannot be drained. It is known to all practical men that the success of irrigations depends on the water being speedily brought on and rapidly carried off, and the land thoroughly drained, either by natural or artificial means, so that, in the present state of the river, all the advantages of irrigation are lost to nearly the whole of this district, while the water which remains beyond what the soil can absorb acts most injuriously, by maintaining a cold and low temperature, not only upon the surface, but to a considerable depth, neutralizing the power of the sun, decaying the tender plant, and altogether retarding the process of vegetation."

Report by J. M. Rendell, Esq., F.R.S., September, 1840.—"I accordingly commenced my examination of the two branches of the Nene some miles above Northampton, and consider that the drainage-works should begin on its northern fork at about one mile above Chapel Brampton, and on its western fork at Kislingbury. From these places to—say Woodstone Staunch, near Peterborough, I consider the only practicable plan of effecting an efficient drainage, having reference to the various interests and the cost, will be—to remove some of the mills—to lower the head-ponds and tail-streams of others—to make proper over-falls and back-drains along the head-ponds of all the mills where the water is impounded above the proper level for the drainage of the adjoining land—to construct sufficient waste-weirs to take the flood-waters—to enlarge and straighten all the overflow or back brooks—to cut off some of the worst bends in the present river-course—to deepen the shallows—to remove most of the staunches on the navigation—to alter some of the locks—to deepen some of the ponds between the same—and, finally, to properly adjust all the bridges, including those of the railway and flood-water courses, to the quantity of water due to every part of the valley.

"By a carefully-devised plan of this nature, I consider only a limited number of mills will have to be removed to insure to all the low lands of the valley a clear drainage of from two to four feet, or in other words, to place the surface of the meadows at that height above the ordinary level of the water in the main drains. Such a scheme would obviously free the valley from all ordinary or summer floods."

Considerable injury is also done to the part of the county adjoining the river Welland by the bad state of the drainage, and the obstructions caused by the flour-mills on the stream. From the vicinity of Market Harborough to Market Deeping, a distance of more than 30 miles, the meadows are repeatedly overflowed and much injured. During high floods the water above Uffington overflows and runs over the meadows and lowlands of Bainton, Helpstone, Maxey, and Elton, uniting again with the river at Waldram Hall, near Crowland.

There is also room generally for improvement in the cultivation of the soil by a judicious application of increased capital. Not unfrequently the desire to obtain land has led tenants to increase their occupations without having a corresponding increase of capital, and the consequence has been that the land has suffered in condition, while they have not profited by their increased holding. No farmer can cultivate with success more acres than he has capital to manage, and it is far better to invest more capital in the farm in his occupation, providing it can be done with profit, than to increase his tenancy, thereby withdrawing a portion of his capital. In every parish there exists considerable difference of produce from the same quantity of acres of the same description of land, owing entirely to the different modes of management. It is highly probable that many farms might be greatly improved by the introduction of root crops on the fallow; by the consumption of a considerable part of the spring corn as food for fattening cattle; by a more complete drainage, and greater attention to the extirpation of weeds; by the adoption of the best kinds of implements and machinery, and by the introduction of those artificial manures to the turnip crops that are likely to promote their rapid early growth. The man who now expects to succeed in the cultivation of the soil, and to maintain his position in the struggle of life, which is becoming daily more severe, must lay aside the prejudices and preconceived opinions of his forefathers, and adopt the onward progress of an improved husbandry.

It may not be out of place to refer to the desirableness of a superior system of education for farmers' sons who intend to follow the occupations of their fathers.—In order to unite "practice with science" it now becomes absolutely necessary that the succeeding generations should not grope along in the dark, as many of us "practical men" have done all our lives. We follow a certain routine of cultivation gathered from experience and observation—we supply our fields with manure, but we cannot tell anything about its component parts, or its adaptation to supply the requisite food for the succeeding crop, and no doubt we often make many mistakes. I do not expect that this sentiment will find much favour with a very numerous class who loudly exclaim against all "*book-farming;*" but I am willing to leave the matter to the calm judgment of those who are disposed to form an unbiassed opinion on the advantages of improvement in the education and training of farmers' sons. I do not see why they should not as skilfully make a chemical experiment as plough a straight furrow or drive a hard bargain.

In conclusion, I tender my sincere thanks to my brother farmers, for the very ready and kind manner in which they have assisted me with information on various subjects contained in this

report. It has been my endeavour to condense within its limits a faithful account of the systems of cultivation and state of agriculture in general throughout the county. In its preparation I have myself derived some very useful information, and have had the pleasure of extending my acquaintance with many of the practical farmers of this my native county.

Handley Farm, Towcester, February 23, 1851.

IV.—*Experiments in Fattening Cattle on different descriptions of Food.* By Colonel McDouall, of Logan, Scotland.

The first set of experiments was undertaken in order to determine the economic value to the farmer of different varieties of green crops, and the most advantageous mode of converting them into money by feeding cattle on the farm. With the exception of Nos. 7, 9, and 10, the same money's worth of artificial food, corn, cake, or linseed in addition, was given in various combinations, to each lot of three or of four beasts, and at a cost per head of 6*s.* 4*d.* per month.

Table I.

Particulars of Food and Management.

Experiment 1.

Lot 1. *Mangold-Wurzel and Bean Meal.*—Each animal consumed on an average 84 lbs. of mangold per day (two-thirds red and one-third yellow) divided into 3 feeds; and had likewise at midday an allowance of 3 lbs. of bean meal daily for 56 days, which was increased to 5 lbs. daily for the remaining 44 days; 5 lbs. of straw were consumed daily as fodder, four-fifths being oat and one-fifth wheat straw. There was no change in the daily consumption of mangold.

Lot 2. *White Carrots and Bean Meal.*—Each animal consumed on an average 108 lbs. white carrots per day, divided into 3 feeds, and had likewise at midday an allowance of 3 lbs. bean meal daily for 56 days, which was increased to 5 lbs. daily for the remaining 44 days; 5 lbs. of straw was consumed daily as fodder, four-fifths being oat and one-fifth wheat straw. At the commencement the cattle consumed 111 lbs. of carrots daily, but this gradually decreased to 76 lbs.

Lot 3. *Turnips grown on separate Fields of different Qualities.*—Each animal consumed on an average 120 lbs. swedes per day, divided into 3 feeds, and had likewise at midday an allowance of 3 lbs. bean meal daily for 56 days, which was increased to 5 lbs. daily for the remaining 44 days. Fodder same as before. At

the commencement the cattle each consumed 126 lbs. turnips daily, but this gradually decreased to 112 lbs.

Experiment 2.

Lot 4. *Turnips grown with Guano and Bones on inferior Land worth a Yearly Rent of* 15*s. per Acre.*—Each animal consumed on an average 104 lbs. swedes per day, divided into 3 feeds, and had likewise at midday an allowance of 3 lbs. bean meal daily for 56 days, which was increased to 5 lbs. daily for the remaining 44 days. The same fodder as before. At the commencement the cattle consumed 126 lbs. of turnips daily, but this gradually decreased to 98 lbs.

Lot 5. *Turnips manured with Dung, Guano, and Bones, and grown on good Land worth a Yearly Rent of* 25*s. per Acre.*—Each animal consumed on an average 104 lbs. swedes per day, divided into 3 feeds, and had likewise at midday an allowance of 3 lbs. bean meal daily for 56 days, which was increased to 5 lbs. daily for the remaining 44 days. The fodder and consumption of turnips same as No. 4.

Experiments 3 and 4.

Lot 6. *Two Feeds Turnips and One Feed Cooked Food.*—Each animal consumed 84 lbs. of swedes per day, and 1 feed of cooked food at noon, consisting of 3 lbs. cut straw boiled along with 3 lbs. bean meal, for 56 days, and for the remaining 44 days the same quantity of turnips and cut straw cooked with 5 lbs. of bean meal daily. Fodder same as before. Same quantity of swedes consumed daily during the experiment. The cost of fuel and extra labour is added to the expense of this and the next experiment.

Lot 7. *One Feed Turnips and Two Feeds Cooked Food.*—Each animal consumed 42 lbs. of swedes and 2 feeds of cooked food daily, each feed consisting of 3 lbs. bean meal boiled along with 3 lbs. cut straw, for 56 days, and for the remaining 44 days the same quantity of turnips and cut straw and 2 feeds cooked food, each containing 5 lbs. bean meal. Fodder the same as before. Same quantity of swedes consumed daily during the experiment.

Lot 8. *Cattle fed on Two Feeds Turnips per day and One Feed Cooked Linseed compound.*—Each animal consumed for the first 56 days 79 lbs. swedes per day and 1 cooked feed consisting of 1½ lbs. linseed boiled with 3 lbs. of cut straw, and the remaining 44 days the same quantity of swedes with 2 lbs. linseed boiled with 3 lbs. cut straw. Fodder same as before. Same quantity of swedes consumed daily during the experiment.

Lot 9. *Cattle fed on Three Feeds Turnips per day with Straw alone.*—Each animal consumed 126 lbs. of swedes per day, and 7 lbs. of straw for fodder, four-fifths oats and one-fifth wheat straw.

Lot 10. *Cattle fed on Three Feeds Turnips per day and Rye-*

grass Hay.—Each animal consumed 126 lbs. of swedes per day and 7 lbs. of rye-grass hay for fodder. The hay, which was purchased, was of inferior quality, having been over ripe, and the growth of the preceding year.

Experiment 5.

Lot 11. *Cattle fed on Three Feeds Turnips per day with Rape and Oil-cake.*—Each animal consumed on an average 118 lbs. swedes per day for 56 days with $1\frac{1}{3}$ lbs. of rape and $1\frac{1}{2}$ lbs. of oil-cake mixed, and the remaining 44 days each animal consumed 118 lbs. swedes and $2\frac{2}{3}$ lbs. oil-cake with $2\frac{1}{3}$ lbs. rape-cake per day, and 5 lbs. of straw daily for fodder. At the commencement the cattle consumed 126 lbs. turnips daily, but this gradually decreased to 110 lbs.

Lot 12. *Cattle fed on Three Feeds Turnips per day and Oil-cake.*—Each animal consumed on an average for the first 56 days 119 lbs. of swedes and $2\frac{1}{4}$ lbs. of oil-cake per day along with the noonday feed, and the remaining 44 days each animal consumed 119 lbs. of swedes per day and 4 lbs. of oil-cake. Fodder the same as before. At the commencement the cattle consumed 126 lbs. of turnips daily, but this gradually decreased to 112 lbs.

Lot 13. *Cattle fed on Three Feeds Turnips per day and a mixture of Oil-cake, Oats, and Bean Meal.*—Each animal consumed 126 lbs. of swedes per day, and $\frac{3}{4}$ lb. of oil-cake, 1 lb. of oats, and 1 lb. of bean meal mixed together, for 56 days, and for the remaining 44 days the same quantity of swedes per day, and $1\frac{1}{3}$ lbs. oil-cake, $1\frac{1}{3}$ lbs. oats, and $1\frac{2}{3}$ lbs. bean meal. Straw for fodder as before.

N.B. The same money-value (1*l.* 1*s.* $3\frac{1}{2}$*d.*) of artificial food, in different combinations, was given to all the lots except No. 7, which received double allowance, and Nos. 9 and 10, which got none.

All the cattle were accustomed to their different kinds of food for three weeks before the experiment commenced.

The difference between the feeding quality of the swedes grown on good and on inferior land, Nos. 4 and 5, may be partly accounted for by the latter having been grown on land which had carried turnips in the previous rotation, and, being a very bulky crop, the roots were less solid, while the former was a first crop, much inferior in size and weight, but the roots more firm and solid.

The cattle were all Galloway bullocks, $2\frac{1}{2}$ years old when put up to feed, of about equal size and quality, having been selected for this experiment out of a large number.

The bean meal cost 6*l.* 3*s.* per ton; the oil-cake, 8*l.*; rape-cake, 4*l.* 10*s.*; linseed, 13*l.* 15*s.*; and oats, 2*s.* 5*d.* per bushel of 40 lbs.; rye-grass hay, 6*d.* per 28 lbs.

TABLE I.—Experiment in Feeding Thirty-nine Cattle on Logan Mains, Wigtonshire, N.B., in thirteen lots of three each, with different specified varieties of Food, for 100 Days, from 17th December, 1851, to 26th March, 1852.

Lots.	Live weight of three Cattle on 17th Dec., 1851, ascertained by actual weight.	Live weight of three Cattle, 26th March, 1852, ascertained by actual weight.	Weight per head, sinking offal, when put up to feed, at 4*s.* 4*d.* per stone.			Weight per head, sinking the offal, at conclusion of experiment, at 5*s.* per stone.			Value of Increase per head, sinking offal.	Total Cost of Food per head, including the price of Artificial Food, and allowing 8*s.* per ton for mangold and carrots, and 6*s.* for swede turnips.	Comparative *Gain* or *Loss*, exclusive of manure.	
			No. of Stone.	Rate.	Amount.	No. of Stone.	Rate.	Amount.			Gain.	Loss.
	cwt. qrs. lbs.	cwt. qrs. lbs.		s. d.	£. s. d.		s. d.	£. s. d.	£. s. d.	£. s. d.	s. d.	s. d.
1	25 0 14	29 1 20	37	4 4	8 0 4	43	5 0	10 15 0	2 14 8	2 11 3½	3 4½	
2	25 3 15	30 1 12	38	4 4	8 4 8	44½	5 0	11 2 6	2 17 10	2 19 10¼	..	2 0¼
3	25 3 5	30 0 20	38	4 4	8 4 8	44	5 0	11 0 0	2 15 4	2 13 5	1 11	
4	25 2 4	29 2 8	37½	4 4	8 2 6	43½	5 0	10 17 6	2 15 0	2 9 1¾	5 10¼	
5	25 1 7	28 3 23	37½	4 4	8 2 6	42½	5 0	10 12 6	2 10 0	2 9 1¾	0 10¼	
6	25 3 13	29 2 24	38	4 4	8 4 8	43½	5 0	10 17 6	2 12 10	2 6 9½	6 0½	
7	25 2 23	29 0 13	37¾	4 4	8 3 7	42½	5 0	10 12 6	2 8 11	3 1 1	..	12 2
8	24 2 4	28 0 7	36	4 4	7 18 0	41	5 0	10 5 0	2 7 0	2 5 10½	1 1½	
9	25 2 17	28 0 3	37½	4 4	8 2 6	41	5 0	10 5 0	2 2 6	1 13 9	8 9	
10	25 2 26	28 3 11	37½	4 4	8 2 6	42	5 0	10 10 0	2 7 6	2 6 3	1 3	
11	25 3 18	29 2 9	37¾	4 4	8 3 7	43	5 0	10 15 0	2 11 5	2 12 9½	..	1 4½
12	25 3 15	29 3 10	38	4 4	8 4 8	44	5 0	11 0 0	2 15 4	2 13 2	2 2	
13	25 2 23	30 0 22	37¾	4 4	8 3 7	44	5 0	11 0 0	2 16 5	2 15 0½	1 4½	

The first three lots in this series bring into contrast, under equal circumstances, the feeding properties and value of mangold, white carrots, and swedes. In 100 days each animal consumed in each lot respectively—

Lot 1.	Mangold	75 cwt.
,, 2.	White carrots . . .	$96\frac{1}{2}$,,
,, 3.	Swedes	107 ,,

After deducting the value of the artificial food in each case, the increase of weight on the animal leaves $5\frac{1}{4}d.$ per cwt. for the mangold, $4\frac{1}{2}d.$ for the white carrots, and $3\frac{3}{4}d.$ per cwt. for the swedes. In this northern part of Great Britain 20 tons of mangold, 20 tons of white carrots, and 30 tons of swedes are found to be nearly the equivalent produce of an acre of land similarly manured and managed. At these prices

	£.	s.	d.	
Mangold yields here . . .	8	15	0	per acre.
White carrots	7	10	0	,,
Swedes	9	7	6	,,

The number of fattening cattle which a farm maintains is a good criterion of its fertility, and provided that they are profitably kept, the more a farmer can keep the more will he enrich his farm. It is therefore important for him to know the description of green-crop which will profitably support the largest head of stock. These experiments show that an acre of

Mangold	yields 6	months' green food	for 3	stall-fed cattle.
White carrots	,,	,,	$2\frac{1}{3}$	,,
Swedes	,,	,,	$3\frac{1}{8}$	,,

so that the farmer in this climate, who should grow 20 acres of green-crops, could keep (with the aid of the artificial food already mentioned) 67 head of fattening cattle on that quantity of swedes, 60 head on the same extent of mangold, and only 47 head on an equal breadth of white carrots. These figures must be taken relatively rather than absolutely, for there is always a certain amount of unavoidable waste in the details of management.

In the south-eastern and southern counties of England, where the climate and soil are more favourable to the growth of mangold than swedes, and where the proportion per acre would be nearly inverted, 30 tons of mangold and 20 tons of swedes being there equivalent crops, the great superiority of the mangold for those districts is strikingly shown by this experiment.*

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* There is no doubt that in this part of England (Berkshire, for instance) it is as easy to grow 30 tons of mangold as it is to grow 20 tons of swedes to the acre. Assuming Colonel MacDouall's results to be such as would ordinarily take place, the superior profit of mangolds over swedes is very great; for the money-returns will stand as follows:— Mangold

2nd. Nos. 4 and 5 were experiments made to test the different feeding qualities of swedes grown on land of good and inferior quality. Precisely the same weight of food was daily supplied to each animal. The feeding quality of the swedes from inferior land shows a superiority to that from good land, the former giving a return of 4¼*d.* per cwt. against 3¾*d.* from the latter. This receives some explanation from the fact that the crop on inferior land was a solid small crop of 20 tons an acre, while that on good land was a comparatively heavy, but more spongy crop of 30 tons an acre. While the superior feeding quality of the less bulky but more solid crop, weight for weight, is thus proved, the result is different where the economical value to the farmer of each crop is considered. The respective crops yield—

	£.	s.	d.
Inferior land, 20 tons per acre, at 4¼*d.* per cwt. . .	7	1	8
Good land, 30 ,, ,, 3¾*d.* ,, . .	9	7	6
In favour of good land . . .	2	5	10

which is very much more than the difference of rent.

3rd. Nos. 6, 7, 8, and 9 are experiments to determine the advantage of, and how far prepared food may be economically substituted for, swedes in the fattening of cattle. Where one cooked feed per day is given with two feeds of raw swedes, as supplied to Lot 6, the result is the most profitable of all. The farther substitution for another feed of raw swedes, of a second portion of cooked food, extinguishes the profit, by the increased expense of the dearer food. In a tabular form the result of these experiments shows that an acre of swedes (30 tons), when consumed by fattening cattle in stalls, gives a return to the farmer, after deducting the cost of artificial food, in the following order, viz.—

No.		£.	s.
6.	One cooked feed of corn, and two of raw swedes, per day	12	10
8.	Ditto linseed compound and ditto ,, ,, ,,	11	5
9.	No corn, three feeds of raw swedes . . . ,,	11	5
7.	Two cooked feeds of corn and one of raw swedes ,,	5	0

	£	s.	d.	
Mangold	13	2	6	per acre.
Swedes	6	5	0	,,

The money-return from the mangold therefore appears to be more than double that from the swede. There is also the great advantage of the land being clear for the timely sowing of barley, by feeding stock on mangold, which, of course, has been stored, instead of keeping the sheep on swedes run to seed in April, while the seedtime for barley is passing or gone. This experiment strongly confirms those of the late Lord Spencer, which appeared some years since in this Journal. The laxative tendency of mangold is easily, as in this case, counteracted by the accompaniment of bean-meal.—Ph. Pusey.

It thus appears that it pays well at the present relative prices of corn and meat to give about 4 lbs. of bean-meal per day, cooked with cut straw, to fattening cattle, but that the profit is converted to loss if this rate is much exceeded.

A comparison between Nos. 3 and 6 gives this farther result, that an acre of swedes, when eaten by two lots of cattle receiving equal quantities of bean-meal, given in the one case in a raw state and in the other cooked with cut straw, will yield in the former 9*l.* 7*s.* 6*d.*, and in the latter 12*l.* 10*s.* The greater bulk of the cooked food is found to be a profitable and sufficient substitute for a certain portion of the swedes, and the farmer's additional profit is made in this substitution of a very cheap kind of food, viz., cut straw and hot water when blended with bean-meal.

4th. Nos. 9 and 10 are experiments to show the relative feeding qualities of different kinds of fodder as auxiliary to swedes. The increased weight of the lot No. 10, fed on turnips and hay, as compared with that fed on turnips and straw, No. 9, bears no proportion to the increased cost of the hay, and is conclusive against the propriety of using rye-grass hay as fodder for turnip-fed cattle. The hay was not of superior quality.

5th. Nos. 11, 12, and 13 form a comparative trial of the effects of different kinds of artificial food, of equal money value, as auxiliaries to swedes in the fattening of cattle; 3 lbs. to 4 lbs. of good oil-cake per day give a better return than a mixture of the same money's worth of oil-cake, oats, and bean meal given dry, or of oil and rape-cake in nearly equal proportions.

Table II.

This experiment was undertaken to show the relative advantage of box, stall, and shed feeding.

Particulars of Food and Management.

All the lots were fed for the first 57 days on 114 lbs. swede turnips per day, divided into 3 feeds, and 4 lbs. of bean meal daily, along with the noonday meal; and for the remaining 57 days 58 lbs. swedes per day given morning and evening, and 3 lbs. cut straw boiled along with 4 lbs. bean meal for the midday feed. All the cattle consumed 4½ lbs. fodder per day, three-fourths of the time oat and one-fourth wheat straw.

The principle adopted in the above experiments was to test the returns which *equal quantities of food* would leave when consumed under the different modes of feeding mentioned. It was thought that a trial made in this way would show clearly which of the three

methods was most advantageous to the feeder. The stall-fed cattle required about 12 lbs. of straw per day for litter, being only one-third of the quantity necessary for each of the other two lots, and during wet weather No. 3 required considerably more.

The accommodation for the stall-fed cattle cost 60*s.* per head; for the box-fed 85*s.*; and for the open-shed and court 65*s.* per head: the buildings being all well finished and substantial.

The expense of attendance was found to be the same in the stall and box-fed cattle, and about one-quarter less in the experiment in open sheds and court, the amount on the two former being 1*s.* per head per month, and the latter 9*d.*

The weather was very wet in the early part of winter, and, though the open sheds and yard were in a sheltered situation, the moistness of this climate may be more unfavourable to that mode of feeding than the drier climate of the east coast.

The cattle were all Galloway bullocks, 2½ years old, when put up to feed, of about equal size and quality, and were all put into their separate places and fed in the same way for 14 days before being weighed.

Table II.—Experiment in Feeding Twelve Cattle in Killumpha, Wigtonshire, N.B., in three lots of four each, on same varieties of Food, from 22nd December, 1851, to 14th April, 1852.

—	No. of Lots.	Live weight of four Cattle, 22nd Dec. 1851.	Live weight of four Cattle, 14th April, 1852.	Weight per head, sinking offal, when put up to feed, at 4*s.* 4*d.* per stone.		
				No. of Stone.	Rate.	Amount.
		cwt. qrs. lbs.	cwt. qrs. lbs.		*s.* *d.*	£. *s.* *d.*
Loose houses or boxes	1	36 0 7	41 3 22	39½	4 4	8 11 2
Stalls	2	35 0 17	40 2 13	38½	4 4	8 6 10
Sheds or hammels .	3	35 3 15	40 2 14	39½	4 4	8 11 2

—	Weight per head, sinking offal, at conclusion of experiment, at 5*s.* per stone.			Value of Increase per head, sinking offal.	Total Cost of Food per head, including the price of Artificial Food, and allowing 6*s.* per ton for swede turnips.	Comparative *Gain* or *Loss*, exclusive of manure.	
	No. of Stone.	Rate.	Amount.			Gain.	Loss.
		s. *d.*	£. *s.* *d.*	£. *s.* *d.*	£. *s.* *d.*	*s.* *d.*	*s.* *d.*
Loose houses or boxes	46	5 0	11 10 0	2 18 10	2 11 3½	7 6½	. .
Stalls	44½	5 0	11 2 6	2 15 8	2 11 3½	4 4½	. .
Sheds or hammels .	44½	5 0	11 2 6	2 11 4	2 11 3½	0 0½	. .

The difference in the result per head in the table is not so striking as when the calculation is carried out to the result per

acre. After the value of the artificial food is deducted, each lot of cattle leaves for the swedes consumed as follows, viz.:—

			£.	s.	d.	
Box feeding gives a return of	$4\frac{3}{4}d.$	per cwt.	11	17	6	per acre.
Stall ,, ,,	$4\frac{1}{4}d.$	,,	10	12	6	,,
Shed ,, ,,	$3\frac{3}{4}d.$	,,	9	7	6	,,

Where litter is abundant, box-feeding proves itself the most remunerative of the three plans, and shed-feeding greatly the least—so very inferior is the result in the last case that a persistence in the practice would be absurd, and it is only as between the first two that a comparison need be drawn. Each stall-fed animal uses about 1 ton of straw for litter during the six months of feeding, while each box-fed animal requires nearly 3 tons. In a dry climate, with a soil suited to sheep-feeding, where two-thirds of the turnips may be consumed on the ground and one-third drawn home for cattle, box-feeding will probably be found in every respect the most advantageous system: where only one-third of the green-crop is to be fed by cattle there will generally be a sufficient supply of straw to furnish the requisite supply for the cattle-boxes; but if either the climate or the soil is adverse to sheep on turnips, and if the whole green-crop must be consumed by cattle, box-feeding with such a supply of litter would be impossible, and stall-feeding therefore indispensable. And where straw is valued as an article of food, the 2 tons saved on each animal by the system of stall-feeding gives it a manifest superiority over the loose boxes.

Table III.

This experiment was undertaken to test the comparative advantage of storing swedes previous to winter, or of using them fresh from the field as required.

Particulars of Food and Management.

Lot 1. Each animal received 111 lbs. swede turnips per day in 3 feeds, and 4 lbs. bean meal daily along with the midday feed, for 69 days; and for the remaining 45 days each animal consumed 50 lbs. of swedes per day in 2 feeds, and a cooked feed at midday consisting of 3 lbs. cut straw boiled along with 4 lbs. bean meal. Each animal consumed $4\frac{1}{2}$ lbs. straw per day for fodder, three-quarters oat and one-quarter wheat straw.

Lot 2. Fed in every way the same, but on turnips previously stored.

Both lots were offered more turnips at various times, but they would not eat them.

The cattle were all Galloway bullocks, $2\frac{1}{2}$ years old when put up to feed, of about equal size and quality.

TABLE III. — Experiment in Feeding Eight Cattle in Myroch, Wigtonshire, N.B., in two lots of four each, from 22nd December, 1851, to 14th April, 1852.

—	No. of Lots.	Live weight of four Cattle, 22nd Dec., 1851.	Live weight of four Cattle, 14th April, 1852.	Weight per head, sinking offal, when put up to feed, at 4*s*. 4*d*. per stone.		
				No. of Stone.	Rate.	Amount.
		cwt. qrs. lbs.	cwt. qrs. lbs.		*s*. *d*.	£. *s*. *d*.
Turnips taken from the fields when required	1	33 2 7	38 2 7	36½	4 4	7 18 2
Turnips stored in November from different parts of the same field	2	32 3 7	38 0 7	36	4 4	7 16 0

—	Weight per head, sinking offal, at conclusion of experiment, at 5*s*. per stone.			Value of Increase per head, sinking offal.	Total Cost of Food per head, including the price of Artificial Food, and allowing 6*s*. per ton for swedes.	Comparative *Gain* or *Loss*, exclusive of manure.	
	No. of Stone.	Rate.	Amount.			Gain.	Loss.
		s. *d*.	£. *s*. *d*.	£. *s*. *d*.	£. *s*. *d*.	*s*. *d*.	*s*. *d*.
Turnips taken from the fields when required	42½	5 0	10 12 6	2 14 4	2 11 7	2 9	..
Turnips stored in November from different parts of the same field	42	5 0	10 10 0	2 14 0	2 11 7	2 5	..

The result is so nearly the same in point of feeding quality that the convenience of the farmer seems the only matter that should give a preference to either plan. It is much, however, to know that the stored swedes are as nutritious as those brought fresh from the field; for the most favourable time may be taken for carting the crop from the field, getting the roots stored dry, near to the feeding-houses, where they are ready in all weather when wanted, clean and comfortable for both the feeder and the cattle —not one day covered with mud and another frozen as hard as a cannon-ball. There can be no doubt as to the great advantage to the soil and the farm horses of carting off this bulky crop during a period of dry or frosty weather.

On this soil, and with our humid and mild autumnal climate, we can calculate on an average crop of 30 tons of swedish turnips an acre. The foregoing experiments show that between 6*s*. and 7*s*. a ton is realised by feeding this crop on the farm over and above the value of the manure. But it must not be overlooked

that the feeding cattle are comfortably housed, and regularly and carefully fed, and that their food is not given to them in wasteful abundance. In many published reports of experiments in cattle-feeding, the weight of roots said to be given to each animal daily is in most cases double, and in some cases treble the quantity which we find sufficient. This may be partly caused by the greater appetite of a larger breed of cattle, partly by allowing the animals to eat a much larger bulk of turnips than their digestive organs can turn to good account, and partly by permitting the animal to waste much of his food in unnecessary exercise or exposure to cold.

With an annual experience in fattening upwards of 250 cattle in stalls and boxes, we find that from 80 lbs. to 100 lbs. of cut swedes per day given in two feeds, morning and afternoon, and a cooked feed at noon, as described in experiment No. 6, is quite sufficient to fatten cattle of from 40 to 50 stones imperial. The substitution of the cooked midday feed for one-third of the former allowance of turnips, has enabled us to increase our fattening cattle by one-third in number, leaving a proportionately larger return per acre for turnips consumed, and a greater increase of valuable manure. Economy in feeding is the great secret of success in making the turnip-crop pay; a certain effect must not only be produced in a given time, but it must be produced at the cheapest cost. As yet we have found nothing equally nutritive and so cheap as 2 feeds of raw swedes per day and 4 lbs. of bean-meal, cooked with an equal weight of cut straw, given as the mid-day feed.

V.—*On the Power of Soils to absorb Manure.* By J. Thomas Way, Consulting Chemist to the Society. (Second Paper.)

In the Midsummer number of the Society's Journal for the year 1850,* I published a paper "On the Power of Soils to absorb Manure," the object of which was, to bring before the Members of the Society some interesting experiments that had been recently made by myself and others in reference to the important question of the action of manures on the soil, and to show the existence of a property in soils, which until that time had not been recognised.

The experiments described in that paper were abundantly sufficient to establish the fact of this new property of soils; they even went so far as to show to what it was *not* to be attributed; but although limiting the possible explanations of the results in question to a comparatively small compass, they were insufficient

* Vol. ix., Part 1.

to teach their true cause, and, as was then explained, it was left for further efforts to carry out this all important branch of the inquiry. I may briefly state here, that in the time that has elapsed since the publication of the above-mentioned paper, I have paid unremitting attention to the prosecution of this investigation, and that the result has been as successful as my most sanguine expectations would have anticipated; I am now in a position to show, with every certainty, the efficient cause of the singular power which soils, especially those of good quality, possess of retaining the manure that is applied to them, and even of acquiring fertility without the direct addition of such manure; and although the present account, like the preceding one, does not, by a great deal, close the inquiry or exhaust the subject, a confident hope is entertained that the reader will find in it much to interest him, and that he will recognise the very material progress which has been made since the last occasion on which his attention was enlisted in its favour.

To save the necessity of reference to the previous paper, and to present the subject in as connected a form as possible, I shall briefly recapitulate the principal results which were there recorded.

In the first place, then, it was found that ordinary soils possessed the power of separating from solution in water the different earthy and alkaline substances presented to them in manure; thus, when solutions of salts of ammonia, of potash, magnesia, &c., were made to filter slowly through a bed of dry soil, 5 or 6 inches deep, arranged in a flower-pot or other suitable vessel, it was observed that the liquid which first ran through no longer contained any of the ammonia or other salt employed. The solution might have been at the commencement of the experiment sufficiently strong to make the detection of the ammonia or the potash, by the proper tests, a matter of great ease, but after filtration through the soil it was no longer to be found; in point of fact the soil had, in some form or other, retained the alkaline substance, whilst the water in which it had previously been dissolved was passing through.

But further, this power of the soil was found not to extend to the whole salt of ammonia or potash, but only to the alkali itself. If, for instance, sulphate of ammonia were the compound used in the experiments, the ammonia would be removed from solution, but the filtered liquid would contain sulphuric acid in abundance —not in the free or uncombined form, but united to lime; instead of sulphate of ammonia we should find, after the experiment, sulphate of lime in the solution; and this result was obtained whatever the acid of the salt experimented on might be. When the sulphates of ammonia, potash, magnesia, &c. were

employed, the filtered liquid contained sulphate of lime; when muriates or nitrates of these alkalies were operated upon, muriate or nitrate of lime was found in the place of the former salts. It may be mentioned, also, in this place, that, at a later period of the investigation, it was satisfactorily proved that the quantity of lime acquired by the solution corresponded exactly to that of ammonia removed from it—the action was therefore a true chemical decomposition. These experiments were varied in many different ways with results of more or less interest. It was found that the process of filtration was by no means necessary; by the mere mixing of an alkaline solution with a proper quantity of soil, as by shaking them together in a bottle and allowing the soil to subside, the same result was obtained; the action, therefore, was in no way referrible to any physical law brought into operation by the process of filtration.

Again, it was found that the combination between the soil and the alkaline substance was rapid, if not instantaneous, partaking therefore of the nature of the ordinary union between an acid and alkali. In the course of these experiments several different soils were operated upon, and it was found that all soils capable of profitable cultivation possessed the property in question in a greater or less degree. It was shown that the power to absorb alkaline substances did not exist in sand; that the organic matters of the soil had nothing to do with it; that the addition of carbonate of lime to a soil did not increase its absorptive power for these salts; and indeed that a soil in which carbonate of lime did not occur, might still possess in a high degree the power of removing ammonia or potash from solution, and it was evident that the active ingredient in all these cases was clay. Further trials proved that the stiffest and most tenacious clays taken from considerable depths, which had never since their deposition been exposed to atmospheric influences, and which also were absolutely free from organic matter, or carbonate of lime, that these pure clays possessed, to the fullest extent, the absorptive property. By these experiments the subject was so far narrowed that the origin of the power in question had been traced to the clay existing in all soils. It still, however, remained to be considered, whether the whole clay took an active part in these changes, or whether there existed in clay some chemical compound in small quantity to which the action was due. This question was to be decided by the extent to which clay was able to unite with ammonia, or other alkaline bases; and it soon became evident that the idea of the clay as a whole being the cause of the absorptive property, was inconsistent with all the ascertained laws of chemical combination. I shall here very shortly refer to some of the experiments which were made to

ascertain the quantity of ammonia and other alkalies which a given quantity of different soils would unite with, and remove from solution; I should premise, however, that the same soil was found in different experiments to absorb unlike quantities of these salts, the result being principally affected by the strength of the solution employed.

1000 parts of a soil from the thin land of the Dorsetshire Downs, was found to absorb from solution of caustic ammonia—

In one experiment . .	3.083	grains of ammonia;
In a second experiment .	3.921	,, ,,
In a third experiment . .	3.504	,, ,,
In a fourth experiment .	3.438	,, ,,

these experiments being made, as just stated, with solutions of differing strength, to which alone the variations are to be referred, since two experiments made under similar conditions invariably gave corresponding results.

The same soil, when brought into contact with muriate of ammonia, instead of the caustic alkali, gave the following result: 1000 parts of soil absorbed 3.478 of ammonia, the strength of the liquid being the same as in the last experiment with caustic ammonia, with the result of which it closely agrees.

1000 grains of a light red soil, from Mr. Pusey's estate in Berkshire, absorbed—

From caustic ammonia . .	1.570	grains of ammonia.
From muriate of ammonia .	1.966	,, ,,

A sample of very tenacious white clay, from the plastic clay formation, gave the following results with solution of muriate of ammonia:

1000 grains absorbed 2.847 grains of ammonia.

This clay contained no carbonate of lime, and it was accordingly mixed, in a second experiment, with some pure chalk, and digested with muriate of ammonia, as before, when—

1000 grains absorbed 2.820 grains of ammonia,

or a quantity identical, within the limits of errors of experiments, with the previous instance, proving what was a short time ago stated, that carbonate of lime was not necessary to, and played no part in, the changes in question.

Two other experiments with this same clay, and different quantities of solution of muriate of ammonia, gave for the absorption, by 1000 grains—

In the first experiment . .	2.078	grains of ammonia.
In the second experiment .	2.010	,, ,,

It is sufficient to quote these experiments, to show to what extent the power of absorbing ammonia exists in different soils. I now recapitulate two experiments made with a salt of potash.

1000 grains of the same white clay, digested with different solutions of nitrate of potash, absorbed—

In one experiment . . .	4.366 grains of potash.
In a second experiment . .	4.980 ,, ,,

In these results it is plain that there is a decided negative to the supposition, that the *whole* clay is active in absorbing the ammonia or potash. We know that chemical combinations always take place in certain definite proportions between the substances combining. Supposing, then, that the clay, as a whole, acting as a definite chemical compound, united with ammonia, we should expect it to absorb *at least* 2 or 3 per 100; whereas it requires 1000 grains of clay to remove this quantity.

I was, indeed, convinced, at a very early period of this inquiry, that the absorptive property was due to a small quantity of some definite chemical compound existing in the clay, and possibly not constituting more than 4 or 5 per cent. of its whole weight. I had every hope that, although I might not be able to separate this substance from clay—for of that there was little prospect—it might yet be possible to form it artificially from other sources at the disposal of the chemist, and by producing a compound, or compounds, having the same properties as those shown to be possessed by clay, to prove their identity with the active principles of clay itself, and thus indirectly establish its real nature. I am satisfied that this point is gained, and I now proceed to describe the nature of the result, and to give a very short history of the steps by which that result was obtained.

It will be remembered that, in the experiments described in my first paper, a salt of lime was invariably found in the resulting solution, and since many of the soils that were employed did not yield to pure water any considerable quantity of lime, and therefore did not contain any soluble salt of this base; as, further, they did not give, when treated with acids, any indication of the presence of carbonate of lime, it followed that the lime compound in the soil could not be one of the ordinary salts of lime—not, for instance, the sulphate, nitrate, or muriate, all of which are soluble in water—nor, as has been said, the carbonate.

That this active substance in the soil was really a *salt* of lime, and not the free or caustic earth itself, was also evident, from the facts, first, of want of solubility, as in the other cases; and, secondly, that the retention of the ammonia and potash by the soil could only be in the form of some insoluble salt of those alkalies, and could not have occurred without the existence of some similar salt of lime with which to interchange. What, then, was the nature of that salt? The large quantity of silica present in soils, some of which was known to exist in the form of silicates

of lime, and other alkaline silicates, seemed to point to the salts of this acid as most probably the true cause of the absorptive property; but so little was, and is even now, known of the silicates, except as they are met with in the different igneous rocks, that it became necessary to institute a distinct inquiry into the nature of these compounds; and the result of that inquiry has been to extend very largely our acquaintance with them, and to show the existence of some salts of the class hitherto unknown.

It is not my intention, in this place, to enter into any detailed account of these experiments, which are necessarily of an abstract character; and I shall content myself with reporting so much of the results as may serve to show the agricultural bearings of this inquiry. When a solution of silicate of soda or potash is added to a neutral solution of a salt of lime, or to lime water itself, a gelatinous precipitate is obtained, which is silicate of lime; this compound may be washed in distilled water, in which it is very slightly soluble. Its composition varies according to the relative proportions of soda and silica in the liquid from which it is formed, but it is possible to obtain it of definite composition. The silicate of lime thus formed was digested in solutions of muriate of ammonia, but without success; it did not absorb ammonia, and is not therefore the substance to which the absorptive property of soils is due. The silicate of lime is the type of simple silicates of the same class, which would be quite unlikely to act otherwise than it did with salts of ammonia. The class of simple silicates was therefore abandoned, and attention was turned to the possibility that the absorptive property might be due to some of the compound silicates present in clay, and derived from the granitic rocks to which clay owes its origin. Fragments of such rocks are found still to be present in clay, and the most commonly known are felspar, the double silicate of alumina and potash, and albite, which is a soda felspar, or double silicate of alumina and soda. There is also a similar double silicate of alumina and lime. These different natural silicates, finely powdered, were digested in a solution of sal ammoniac, but none of them possessed the power of combining with its ammonia. It is not, therefore, to the undecomposed remains of the granitic rocks that the absorptive power of clay is to be referred. It was still possible, however, that these double silicates, when formed artificially by precipitation, might be capable of effecting that which in the mineral state they were unable to accomplish, because it is a well known fact in chemical science, that substances recently formed, and in the highly divided state resulting from precipitation, may be much more active to produce or undergo chemical change, than after they have, as in the case of the granitic rocks, been subject to the agency of heat. Accordingly, the next attempt

was to produce artificially, and without the aid of heat, salts of the same composition as felspar and albite. This was done by adding to a solution of alum a solution of silicate of soda; a gelatinous precipitate was produced, which, when washed and dried, was found to contain soda, and to be not silicate of alumina, but a compound of this latter silicate with silicate of soda. This substance, therefore, resembles albite, which has been before mentioned as a double silicate of alumina and soda.

The experiment was made as in the other cases of digesting this salt in solution of muriate of ammonia; the excess of the latter salt being washed away by successive quantities of distilled water, the precipitate was dried and examined for ammonia, which it was found to contain in very considerable quantity.

I may shortly state here, that with these double silicates of alumina and other bases the greater part, if not all, the phenomena of absorption of manures are connected; and, without detaining the reader with further accounts of the steps of the inquiry, I shall proceed to describe these salts, the method of forming them, and the changes which they undergo under different circumstances.

It is just possible that these compounds, which I believe to have a very important relation to the growth of plants, may at some future time be manufactured at a sufficiently low cost to make them available as manure; and this must be my apology for describing the mode of making them with the greatest advantage, which would otherwise be quite unnecessary.

The first step is the production of the silicate of soda. When carbonate of soda is fused, at a high temperature, with sand or powdered flint, a glass is obtained, which is more or less soluble according to the proportion of soda employed. The greater the proportion of alkali the more soluble is the silicate produced. The formation of silicate of soda in this way is, however, very troublesome and costly, on account of the high temperature necessary, and the consequent destruction of the furnaces. A more easy and economical method of obtaining an alkaline silicate is that pursued by Messrs. Ransome and Parsons, of Ipswich, in the manufacture of their patent artificial stone. A solution of caustic soda is heated in contact with unbroken flints in large high-pressure boilers; the temperature becomes very high, and under its influence the flints in a few hours soften and melt away, the result being a strong solution of silicate of soda.

From silicate of soda formed by either of these methods the different double silicates may be produced.

Double Silicate of Alumina and Soda.—This compound is formed whenever soluble silicate of soda is added to a solution of a salt of alumina, but the relative proportions of the ingredients

in the product depend entirely upon those of the solutions used.*

The double silicate, which contains the smallest per centage of silica and therefore the highest per centage of soda, would be most important in an agricultural sense. It is best made in a state of purity as follows :—From a solution of common alum the alumina is precipitated by carbonate of soda ; and after being washed with pure water, it is dissolved in caustic soda; a solution of silicate of soda containing not more than one equivalent of silica to one of the alkali, but in which any convenient excess of soda may be present, is then added to the alkaline aluminous *liquid;* the resulting precipitate is the double silicate required. It may be washed with pure water till all the caustic soda is removed, and dried at the temperature of boiling water. As thus prepared it is a fine white powder containing water of combination ; but in the following composition I have excluded the water, which is about 12 per cent., and calculated the proportions on the anhydrous salt.

It contains in 100 parts—

Silica	52.41
Alumina	29.68
Soda	17.91
	100.00

It is only very slightly soluble in pure water—an imperial gallon having been found to dissolve 3.36 grains of soda. Indeed with this, as with the silicates which are yet to be described, it is hardly proper to speak of the compounds as being soluble, since the salt does not dissolve as a whole, but is decomposed—silicate of soda being separated whilst the silicate of alumina remains undissolved.

From this soda silicate the other compounds of the same class may be readily prepared.

Double Silicate of Alumina and Lime.—When the double silicate of alumina and soda is digested in excess of lime-water, or of any neutral salt of lime, an absorption of the lime takes place, soda being at the same time dissolved, and the result is, the production of the lime double silicate. It is found difficult in practice to separate the whole soda, but in several cases the substitution of lime for the former alkali has been almost com-

* There appear to be at least three definite silicates of soda in which the silica is to the soda in the proportion of 1, 2, and 3 equivalents. I have succeeded several times in forming a solution of silicate of soda or of potash with the highest proportion of silica, but of course the smaller quantity is much more easily dissolved. If in making the double silicate *alum* be used, three equivalents of silica must enter into the compound for each equivalent of alumina; but when made as described in the text, the lowest possible proportion of silica is the result—that is to say, one equivalent for each equivalent of base.

plete. The composition of the double silicate of alumina and lime in 100 parts is—

Silica	53.33
Alumina	30.21
Lime	16.46
	100.00

Like the corresponding salt of soda the lime double silicate yields to water small quantities of the silicate of lime, but does not dissolve as a whole.

Double Silicate of Alumina and Potash.—This salt may either be formed directly in the same way as the double silicate of alumina and soda, by using silicate of potash instead of soda in the precipitation, or it may be obtained by digesting either of the two salts already described in sulphate or nitrate of potash, when the soda or lime is dissolved out and replaced by potash. Its composition in 100 parts is—

Silica	47.97
Alumina	27.17
Potash	24.86
	100.00

From this salt 1 gallon of water was found to dissolve 2.27 grains of potash.

Double Silicate of Alumina and Ammonia.—When any of the foregoing compounds are digested in sulphate or muriate of ammonia, an absorption of the ammonia takes place whilst the alkali previously in the double silicate dissolves out. The ammonia double silicate is very conveniently formed from the double soda silicate; it is, like the other salts, a fine white powder, which theoretically should have the following composition:—

Silica	53.96
Alumina	30.57
Ammonia*	15.47
	100.00

It should, however, be stated that this theoretical composition has not yet been attained. Very many different quantities of the ammonia silicate have been prepared, but the proportion of ammonia has fallen much short of that mentioned above, after due allowance has been made for the water of combination, which always reduces the proportion of the different ingredients.

* The chemical reader will understand that by *ammonia* here is meant the oxide of ammonium (NH_4O.); the per centage proportion of *ammonia* (NH_3) will be theoretically considerably less—namely, 10.01.

The following numbers give the per centage of ammonia (NH_3) in different samples as actually prepared:—

First sample	4.51
Second sample	5.64
Third sample	5.32

The double silicate of alumina and ammonia is only very slightly soluble in water, as the following experiments will show:—

26.64 grains of double silicate were digested in 16,000 grains of distilled water—the filtered solution gave 0.2195 grains of ammonia, or 0.96 grains to the gallon.

29.80 grains of double silicate were digested in 16,000 grains of distilled water—the filtered liquid contained 0.265 grains of ammonia, or 1.160 grains to the imperial gallon.

This is a very small degree of solubility, as will be seen when it is remembered that carbonate of lime, which is considered an almost insoluble substance, dissolves in water (free from carbonic acid) to the extent of two grains in the imperial gallon. The double silicate of alumina and ammonia loses ammonia at a temperature considerably under the boiling point of water, and it is entirely deprived of it by a red heat.

The double magnesian silicate resembles those already described, but has not yet been fully examined.

I have avoided giving any detailed technical account of these salts, and have only mentioned those particulars in their history which bear upon the agricultural question. It is necessary, however, to notice some points in relation to them as a class. In the first place, it will have been observed that there is a regular order of decomposition between the silicates of each base and ordinary salts of other bases: thus the soda silicate is decomposed by salts of either lime, potash, or ammonia; the potash silicate again is decomposed in its turn by lime or ammonia; and, lastly, the lime compound by ammonia. The different bases may be arranged in the order in which they replace each other from the silicate as follows:—

Soda,
Potash,
Lime,
Magnesia,
Ammonia.

That is to say, that from a silicate of alumina and any one of these bases the base will be dislodged by a salt of any of those under it in the list. Nitrate of potash, for instance, will turn out soda from its silicate, and a potash silicate will be formed; whilst ammonia will replace any of the other bases. Of course the reverse of this action cannot occur, and therefore the double

silicate of alumina and ammonia cannot be decomposed by any neutral salt of the other alkalies.

I may mention here a circumstance, which at the time appeared very curious, but is now readily accounted for. In the early investigation on filtration of manures, an experiment was made of passing flax-water through a bed of white clay. As usual, a great absorption of the different bases occurred, but the result differed somewhat from those which had preceded it. I give the account of it as it was reported in my first paper (vol. xi., p. 369): —" It will be observed that the quantities of lime and sulphuric acid in the resulting, are (within errors of experiment) the same as in the original, liquid. The quantity of chlorine is also as nearly as possible the same in both liquids, but in the original flax-water part of it was in combination with potassium, which, after treatment with clay, has been replaced by sodium. We have here two results which were unexpected—the first, that the quantity of lime should not be increased, which seems opposed to the principle before laid down, that lime replaces in the liquid the potash and magnesia previously combined with sulphuric and muriatic acids ; the second peculiarity is the existence in the resulting solution of much more soda than existed in the flax-water itself. This soda can only have been derived from the clay, which we find from the analysis contains this alkali in considerable quantity. It would seem, therefore, that in the present instance soda, and not lime, had acted the part of the substituting base. It is useless at this stage of the investigation to attempt to reconcile these apparent inconsistencies."

These apparent inconsistencies can, however, now be satisfactorily reconciled ; for it is plain that wherever a sufficient quantity of any base high in the above list exists in a soil, the substitution will be confined principally or entirely to it—the white clay in question contained a large quantity of soda silicate, which necessarily took an active part in the absorption of the ingredients of the flax water.

Nothing indeed could more clearly prove the advantage of the course which has been pursued, namely, that of instituting an examination of these compounds in the abstract form rather than confining the inquiry to the soils themselves. Incidentally also we find in this circumstance a very strong ground of belief that the substances now formed and studied *out* of the soil are really those that *in* it are the active cause of the absorptive property, since the results so closely correspond with what they should be, according to the explanation proposed.

In glancing again at this list, it will be seen that all the silicates, without exception, are capable of absorbing ammonia. This is very important, inasmuch as it exhibits so very certain a provision

for the retention of ammonia in soils. It matters not whether one or more of these compounds is present in a soil, so that any one of them is there; the ammonia added in manure, or derived from the atmosphere, will equally be retained. Indeed, this list of the order of these decompositions strikes me as of singular interest, in indicating the care and solicitude of nature in the preservation of the different substances which are essential to the growth of plants, in direct relation, as far as we have been able to learn, to their relative importance. Ammonia, for instance, may well be considered as of the very first consequence to vegetation, and, for its retention, four other alkaline bases are made responsible. Next comes potash, which is also of very great agricultural importance; whilst, at the other end of the list, we have soda, for the retention of which no provision is made, and which is liable to be displaced by salts of all the other bases. Now, it so happens that almost all those chemists who have been much engaged in the examination of the ashes of plants have come to the conclusion that soda is not necessary to vegetation—that is to say, not as a constituent of plants. In the seeds, which are the only perfected parts of plants, soda rarely exists, except in insignificant quantity, and then only as common salt, present, probably, from want of perfect maturity of the seed. In the succulent parts of plants, it is true, soda is found in quantity, but in all probability it only there exists as a part of the unelaborated juice of the plant, and in virtue of the great quantity of water contained in it. It is most interesting, therefore, that not only is there an absence of retentive power for this alkali, but it is also made subservient to the preservation of all those that are of importance.

Lime, which stands next on the list, is again less cared for than potash or ammonia, probably because its abundance in nature is generally a sufficient security.

It is necessary to state, in reference to these decompositions, that the rule laid down only applies to the action of the *salts* of different bases on the silicates. Thus, as has been said, sulphate of lime cannot cause the displacement of ammonia from its silicate; but, on the other hand, the action of the caustic alkali-lime itself would be very different, for not only would silicate of ammonia be decomposed by lime, but the potash of silicate of potash, and alumina, would also be displaced by it.

This point is of great importance, because it is quite possible that the evils of *overliming* of land may be due to the driving off the ammonia of the soil, which constitutes, so to speak, its capital; and what may be only a useful application of lime to one soil may be destructive to another; because, from the smaller proportion of other silicates for the lime to act upon and become absorbed in,

it may attack the ammoniacal compound, and, by driving away the ammonia, impoverish the land.

The action of heat on these silicates is peculiar. It has been before stated, that they contain water of combination, which is driven off at a red heat, but after being strongly heated they lose their property of acting on different salts. For instance, the double silicate of soda, after being heated to redness, no longer absorbs ammonia, or is decomposed by salts of potash.

This is the reason why felspar and albite-substances, of the same composition in all other respects as the artificial silicates, are devoid of the power of absorbing ammonia. It is only in the state of hydrates that the double silicates possess the property in question; and this, again, accounts for the fact which was observed, that the retentive power of clay and soils in general for ammonia was very much diminished, and in some cases entirely destroyed, after the soils had been heated to redness.

We have here a further proof of the identity of these double silicates, artificially produced, with the substances in the soil, which give it the power of absorbing the salts of manure.

I do not think, indeed, that this point admits of much dispute. We find that a power is possessed by soils, which is not referable to the organic matter, the sand, or carbonate of lime which they contain; and further, that pure clays, free from any of the ordinary salts of lime or soda, possess this property in a high degree. Believing that the activity of clay can only be due to some compounds of silica, we are led to examine some of these compounds anew; and whilst it is ascertained that the ordinary simple silicates are not the salts we are in search of, and that the natural double silicates of the type of the felspars, which are likely to exist in clay, are equally devoid of the requisite properties, a new class of substances is discovered, having, though in a far higher degree, all the qualities of the clay itself. It seems that this is, on the whole, as conclusive as any evidence of the kind could be; and we may hereafter, with advantage, employ our knowledge of these double silicates in elucidation of some of the questions of practical manuring.

It being, therefore, proved that the ammonia, potash, and other alkaline ingredients of manure, are under the influence of the soil separated from solution, and converted into double silicates, the question arises, how do plants ultimately obtain their mineral food from the soil? If the compounds so produced are insoluble in water, how is the ammonia or the potash liberated for the purposes of vegetation? The answer to these questions is, that the double silicates are *not* altogether insoluble in water. It is true, indeed, that in my account of the early experiments on the filtrations through soils, I stated that ammonia was entirely

removed from solution by this operation; and I might be pardoned for making such a statement, inasmuch as the quantity that escapes is really so minute that it requires the greatest attention to make it evident at all, and practically it is quite correct to say that all the ammonia is retained. But still it is all-important to the other part of the question—that is to say, to the explanation of the subsequent use of the ammonia by plants—to ascertain whether or not these compounds are at all soluble. The double silicate of alumina and ammonia, when treated with distilled water, gives to it ammonia in very small quantity. It has already been shown that a gallon of water dissolves from this salt about 1 grain of ammonia, or 1 part in 70,000; and, small as this solubility is, there is every reason to believe that, with the large quantity of water circulating through a plant in the duration of its life, there would be sufficient ammonia thus introduced to supply all the nitrogen required for its albuminous constituents. But it has been found that carbonic acid water dissolves ammonia from the double silicate in considerably larger quantity. Thus, 1000 grains of water saturated with carbonic acid digested on the double silicate dissolved out 0.0366 grains of ammonia; and, at the same rate, an imperial gallon would dissolve 2.527 grains. As water, then, naturally always contains this gas, it follows that the solubility of the ammonia will, in practice, be considerably greater than that given for distilled water. Again, it so happens that the double silicate is still more soluble in a solution of common salt. Thus 1000 grains of a solution of common salt containing 1.97 per cent. of salt was found to dissolve 0.33 grains of ammonia, or at the rate of 23·1 grains in the gallon, which is 20 times as much as with pure water. And in a second experiment, where the solution of common salt was of different strength, or 0.1 per cent. of salt, the quantity of ammonia dissolved was 0.047, or 3.32 grains to the gallon. It is probable that many other salts, such as the sulphate of soda for instance, would possess the same solvent power, and this influence cannot fail to be brought into play, because, wherever a salt of ammonia is arrested by the double silicate of soda or other compounds of the class, a corresponding alkaline salt is formed which acts upon the newly-produced ammoniacal silicate. So that either by solubility in carbonic acid water, or in the various salts which are produced in the soil, it is easy to see that the ammonia may be dissolved in quantity sufficient for all the purposes of vegetation. In passing it may be well to suggest that this extra solubility of these silicious compounds in carbonic acid may in part explain the action of carbonaceous matters in the soil. Independently of being a real food of plants, by the carbonic acid which they furnish on

decomposition, they would also indirectly increase the supply, not only of ammonia, but of all the other alkaline substances which are bound up in the form of silicates of small solubility.

Again, the influence of common salt, when used as manure, may depend on a like cause—an explanation which is the more probable, since we have reason, as before said, to doubt the value of soda as an element of the food of plants. And this leads me to mention, very shortly, a conjecture which I have been led to make with regard to the deposition of silica in the straw of wheat and other crops of the same kind.

It has always been a matter of question with chemists, in what way the beautiful coating of silica could be laid on wheat straw: and as the soluble compounds of silica hitherto known have been those of potash and soda only, it has been necessary to suppose that solutions of these salts were decomposed by carbonic acid, and that the silica, in solution in water, was subsequently carried to the straw and there deposited. The discovery of the silicate of ammonia, however, affords a much more satisfactory explanation of this phenomenon. When the double silicate of ammonia and alumina is treated with water, silicate of ammonia dissolves, and this solution, when carefully evaporated, leaves on the dish in which the operation is performed a transparent varnish of silica, hard and brittle, and splitting into thin plates like mica. In the act of evaporation the water carries with it the ammonia, leaving only silica behind. What more natural than to suppose that the silica of cereal crops is thus left by the constant transpiration of water from the surface of their leaves and stalks? A circumstance which in an interesting way favours the view now suggested, is, the observation made by Mr. Lawes that, in the growth of wheat, much more ammonia is removed from the soil than is found in the crop in the shape of albuminous matters; that, indeed, to produce 1 bushel of wheat, containing in round numbers 1 lb. of nitrogen, between 4 and 5 lbs. of nitrogen as ammonia are required in the soil. This singular observation, which has been hitherto without explanation, becomes intelligible enough if it be conceded that the ammonia is engaged in carrying the silica to the straw, and is, if we may so say, wasted in the act. It is also remarkable that this loss of ammonia is apparently confined to the cereal crops and grasses, and is not found to occur in plants that have not silicious stems. I do not wish to push this conjecture beyond its proper limits, and therefore merely mention it as worthy of being borne in mind. If it be in any degree correct, then the action of common salt in strengthening and brightening the straw of wheat and barley, which is the best ascertained of its effects as manure,

is immediately traceable to the greater solubility of the silicate of ammonia in a saline solution.

Hitherto we have spoken only of the power of the double silicates to unite with ammonia, and separate it from *solution.* More important, if possible, is the faculty which some of these salts possess, of abstracting ammonia from the *air.* It has long been known that soils acquire fertility by exposure to the influences of the atmosphere—hence one of the uses of fallows. It has also been generally understood that clay possessed a power of absorbing ammonia from the air, but only through the influence of rain or dews, to bring down the volatile carbonate. This latter condition, however, is not at all necessary. I find that clay is so greedy of ammonia, that if air charged with carbonate of ammonia, so as to be highly pungent, is passed through a tube filled with small fragments of dry clay, every particle of the gas is arrested. In the same way, if into a bottle filled with air similarly impregnated, a little ordinary dry soil is thrown, and the bottle is then shaken once or twice, all ammoniacal smell is destroyed. The double silicate of alumina and lime is in these cases also the cause of the absorption. If, instead of clay, sand be placed in the tube, no obstacle is presented to the passage of the gas; but by mixing with the sand a few grains of the lime silicate we can immediately arrest it. The avidity of this silicate of lime and alumina for carbonate of ammonia is most marked. A few grains of the salt were spread upon a piece of paper, and covered with a glass bell jar, some fragments of dry carbonate of ammonia in a small dish being also covered by the jar; in a few hours the silicate was found to have absorbed between two and three per cent. of ammonia, and the action will go on until the salt is entirely saturated. The chemical change in this case is very simple—the carbonic acid of the carbonate of ammonia attacks the lime, forming carbonate of lime, whilst at the same time the double silicate of alumina and ammonia is produced. It is remarkable that the corresponding soda silicate does not absorb carbonate of ammonia; or, at all events, if it does so in an atmosphere highly impregnated with the volatile alkali, it gives it off again so soon as it is exposed to the air: in ordinary circumstances, therefore, it does not absorb ammonia from the air.*

* This circumstance, which was not anticipated, is, however, of easy explanation. When the lime silicate absorbs carbonate of ammonia, carbonate of lime is formed, and this, being insoluble, does not re-act upon the silicate of ammonia; but, in the other case, carbonate of soda would be one of the products; being a soluble salt, it is enabled to re-act by degrees on the ammonia silicate, which is also slightly soluble, and carbonate of ammonia is the result. In point of fact, it is found that, when the double silicate of alumina and ammonia is mixed with carbonate of *soda*, fumes of carbonate of ammonia at once come off; whereas carbonate of *lime* has no such action on the ammonia silicate.

The power of the double silicate of alumina and lime to absorb carbonate of ammonia from the air is very important in reference to several practical questions in agriculture. The most important of these are the differences in natural fertility of different soils, and the power of conferring increased fertility on land by abundant cultivation. It is not my wish to assert that the dissimilarity in soils in regard to natural capacity of producing crops can be accounted for by reference to any one circumstance; on the contrary, it is certain that very many circumstances may combine to give a superiority to one soil over another; but it is also certain that one soil will be highly enriched by a fallow which will in no degree benefit another. We know that ammonia exists in the air, in small quantity indeed, but when taken as a whole in abundance, materially to affect the growth of plants; now we have seen that silicate of alumina and lime, which exists in soils and which is an ingredient of clay, has the property of abstracting carbonate of ammonia from the air, and retaining it for the purposes of vegetation. As there is good reason to believe that different soils may contain unlike quantities of this double silicate, so they will, other things being the same, possess unlike degrees of natural fertility. In this circumstance we may probably find an explanation of the singular fertility of some soils, of which it is recorded that they have been cropped year after year with wheat, for a very extended period, without any apparent diminution in their power of yielding it. Upon examination, nothing extraordinary has been found in the composition of such soils to account for such a degree of fertility; but it is extremely likely that a further inquiry, with the aid of the light now thrown upon the subject, will show that the superiority of such soils is dependent upon their possession of a greater power of acquiring manure from the air by the means now pointed out. The second practical question to which I have referred, namely, the power of conferring increased fertility by abundant cultivation, is one that might profitably engage a very large share of our attention; but I can only in this place glance very slightly at the connexion between it and the discovery which it is the object of this paper to record. It is now more than a century ago that Jethro Tull published his work on agriculture—a work which contains doctrines so opposed to all the preconceived ideas and established practices of the farmer, that it is to this day looked upon by many an intelligent man as a mere collection of absurd theories: and yet I do not hesitate to say that, making allowances for the imperfect knowledge of the sciences of chemistry and botany of that period, Tull's views were those of a deeply observant and philosophical mind. Tull advocated the constant subdivision of the soil by abundant cultivation at all possible seasons; and the arguments

by which he supported this practice were principally two. The first, which it is merely necessary to mention, was that by the breaking up and subdivision of the particles of soil, a new and constantly increasing food-yielding surface, or as he himself called it "pasture," was provided for the roots of plants.

The second argument was, that by the continual opening and loosening of the soil opportunity was given to the air to enter it, and to confer upon it increased fertility. Tull knew not of what nature those atmospheric influences were, for at that time the names of ammonia and carbonic acid were unknown; but he was nevertheless convinced that the air did exercise some beneficial influence on the soil, and his aim was to court its entrance to the fullest extent.

Of the system which Tull invented to enable him to carry out his peculiar views, it is not my intention to speak. From time to time that system, more or less modified to adapt it to particular circumstances, has been revived by thinking, intelligent men; and at the present time a good deal of attention has been attracted to the novel method of wheat-growing practised by the Rev. Mr. Smith, at Lois Weedon, in Northamptonshire. Accounts of this system have appeared in a late number of this Journal and elsewhere; and as I have no intention of advocating any system, but simply of examining a principle by the application of the rule and square of scientific truth, I shall merely say that Mr. Smith believes with his great predecessor, Jethro Tull, that on fair average wheat-soils deep and abundant cultivation may more than replace manure. I said before that Mr. Smith has published his own account of his experiments and his views on the subject; they go much farther than the bare question above propounded, but this is the question to which I limit my present inquiry, namely—Is it likely, on theoretical considerations, that the air and the soil together can by any means be made to yield without the application of manure, and year after year continuously, a crop of wheat of from 30 to 35 bushels per acre? I confess that I do not see why they should not do so.

We have seen the power which soils possess of abstracting ammonia from the air—this power is not confined to periods of rain, it is not even limited to the periodical recurrence of dew—so often as air charged with carbonate of ammonia comes into contact with a surface of soil, so often will that soil be enriched by ammonia to the extent to which the air contains it. It is impossible to state numerically the amount of ammoniacal manuring which a soil properly prepared might, in 24 hours, or in the course of the year, thus receive, simply because the necessary data are wanting, and we can only therefore judge by results.

Fresenius found that 1,000,000 parts of air contained on the average of 40 days and nights 0.379 parts of carbonate of ammonia, or 0.133 parts of ammonia itself; and although this proportion is very small, yet inasmuch as every time the air is renewed in the porous soil, the whole of the ammonia is removed; and as in a highly-worked soil one-third or one-half of the 1000 tons, of which an acre 1 foot deep consists, may be supposed to be ever on the watch for this prize, it is quite conceivable that the balance between the supply and that required by the crop may be in favour of the former; but this result can only be hoped for when the soil is brought into and kept in a continual state of subdivision and porosity so as to offer the freest welcome to the enriching air, and this it is the object of the Tullian system, as practised by Mr. Smith, to effect. Then again, with ammonia comes carbonic acid, and as this gas constitutes 1 part in 1000 of air, it will be supplied in quantity nearly 10,000 fold more than the ammonia; I do not therefore see why, between the absorption of carbonic acid by the leaves and its supply to the roots in a porous soil, sufficient carbon should not be derived from the atmosphere for all the wants of a growing crop of wheat. But here again we can only conjecture—it is impossible to say positively, on theoretical grounds, that such *would* be the case, but on the other hand it is equally impossible to deny that it *might* be.

With regard to the mineral matters required by a crop of wheat, the inquiry is far more simple. We know very accurately how much the different parts of plants remove from the soil of potash, magnesia, phosphoric acid, &c.; and we know that if they are not added in manure they must be derived from the internal resources of the soil itself—for the air will do nothing here. We further know, from the analyses of soils that have been made, what amount of these substances are usually to be met with in the land.

Now, although it has been a constant axiom in the instructions of chemists to farmers to "return to the soil what the crops remove"—and every candid agricultural chemist will own, that at the outset of his career he has somewhat overrated the importance of literally fulfilling this obligation,—it is certain that most soils of fair quality contain an amount of the different mineral substances far greater than is necessary for many successive crops of the most impoverishing character.

In the table which follows I have given the quantities in pounds of the different mineral substances required by a crop of wheat of 35 bushels of grain and 2 tons of straw and chaff; a second column of the table shows the amount removed by twenty such

crops; and in a third will be found the *per centage* of each which a soil must contain to furnish this last quantity.

	1 Crop.	20 Crops.	*Per Centage of the soil removed by 20 crops.
	lbs.	lbs.	
Silica	170	3400	0·152
Phosphoric Acid . . .	30	600	0·027
Sulphuric Acid . . .	8	160	0·007
Lime	16	320	0·014
Magnesia	10	200	0·009
Potash	40	800	0·036
Soda	3	60	0·003
	277	5540	0·248

Now it is common and usual to find from one-tenth to two-tenths per cent. of potash in ordinary soils, a quantity several times greater than is here shown to be necessary for twenty crops of wheat; and I would ask any chemist acquainted with the analysis of soils, whether he has ever met with a soil which repays cultivation, which had not very much more of all these mineral ingredients than that given in the last column. The fact is, that there is an almost unlimited supply of the mineral requisites of plants in soils, but that the great agricultural problem is to get at them—to render them available; and here again it seems reasonable to suppose that abundant cultivation, which lets in carbonic acid and ammonia to the soil, may by that very act be providing the potash and phosphate of lime which the former, and the silica which the latter, are endowed with the power of dissolving, and presenting to the roots of plants.

But it is plain that there is a limit to all this; and whilst I cannot see why a considerable number of successive crops of wheat might not, by virtue of the manure-collecting and manure-preparing process of abundant cultivation, be raised from land without the direct application of manure, I am decidedly opposed to the principle of continuing this system on the same land for an *unlimited* number of years. The capabilities of the soil, great as they might be, must in that case gradually be diminished, and ultimately fail altogether; besides, such a plan would be unnecessarily hazardous. What is to prevent land that has been cropped successively with wheat on this plan for 10 or 15 years, supposing it has been found to answer for that period, from being changed for other land which has not been exposed to that drain?

With one or two more remarks, I will take leave of this subject

* Calculated on a soil 10 inches in depth, and weighing 1000 tons to the acre.

for the present. We have seen that whenever a salt of ammonia or of potash reaches the soil, and gets distributed through it, a change occurs—a double silicate of alumina and ammonia or potash is formed, and the salt which was added no longer exists there. The ammonia or potash henceforth exists in the soil only in the form of silicate, and is presented to the roots of a plant only in that form, or in the form of carbonate, derived from it by the action of carbonic acid in the soil. And inasmuch as all average soils possess this property of conversion in more than the degree necessary for the quantity of manure which reaches them, the inference is obvious and incontestable, that nature has given to the soil this power for the specific purpose of preparing the food of plants, and we then have the soil occupying a place intermediate between that of mere dead matter and the living organism of plants. Further, if the combinations of these two, so to speak, innocent and mild acids, the carbonic and silicic, are the only ones appointed by nature, it follows that the salts of mineral acids, the sulphates and muriates, are not suited, indeed positively injurious, to vegetation. This may account for the unhealthy grossness of wheat fed with crude ammoniacal salts, which have reached its roots without sufficient incorporation with the soil, whilst wheat grown after the Tullian system seems never to become over luxuriant, for in the latter case, as the ammonia is only obtained by virtue of the power of the soil to abstract it from the air, so it can never exist in it in any other than the form in which it is best suited for the wants of the crop. And this leads me, in conclusion, to remark that it is quite possible that light soils, which, from their want of power of preparing the manure, cannot be safely manured with guano or ammoniacal salts for the wheat crop, might perhaps benefit largely by the use of these double silicates—that an ammoniacal double silicate being the ready formed food of the cereals, might be an admissible source of ammonia when neither guano nor any other source of ammonia could be used. Whether the compounds now described could be produced at a sufficiently cheap rate for any practical application, I cannot at present state; but if so, I think it very probable that they might be of great service in practical agriculture: and owing to the property of solidifying ammonia possessed by some of them, they might be made the means of obtaining this valuable alkali from sources which are not at present available.

I am still engaged in following up the bearings of this highly interesting subject, and shall hope at a future time to have further important results to bring before the attention of the members of this Society.

VI.—*On the Manufacture of Sugar from Beet-Root.* By John Wilson, F.R.S.E., F.G.S., &c. (late Professor of Agriculture in the Royal Agricultural College, Cirencester).

Section I.

"*The cultivation of the root for this purpose in France, Belgium, or Germany, and the extent to which high manuring affects its saccharine contents.*"

The original type of our garden and field beet, or mangold-wurzel, is the *Beta maritima*, or sea-beet, an indigenous plant, found growing wild on many parts of the sea-coast, especially where an argillaceous formation borders the sea line. In such cases it possesses a somewhat fleshy root, a tall branching stem 3 to 4 feet high, with narrow dark-green leaves, which in many places are gathered and eaten readily as a pot-herb. The cultivated varieties are the *B. hortensis*, called also *B. cycla* or Chard beet (which is cultivated for its leaves alone, the central part or midrib being very fleshy, and considered, when cooked, a delicacy), and the *B. vulgaris*, which comprises the red beet of our gardens and the white or Silesian beet, both of which are well known as containing a large quantity of sugar. The variety with which we are best acquainted, the mangold-wurzel, has been supposed to be the result of a cross between these two, and thus possesses certain physical characteristics of them. As the object of this paper is not to treat on the cultivation of mangold-wurzel *generally*, but merely *specially* in its relations with the manufacture of sugar, we need only mention that there are several different varieties of this mangold-wurzel, which are grown indiscriminately in most counties in England. Up to the present time but little attention has been paid to their relative saccharine properties; their feeding values and their suitability for different soils seem to be the only results of the imperfect investigations to which they have been hitherto submitted. On the Continent, however, the necessities of the people brought the root prominently into notice, some forty years ago, as being an indigenous source from which that sugar, so necessary to the comforts of life, could be obtained, which by the Continental Decree of Napoleon they were debarred from procuring from the customary sources, the cane-growing islands of the Atlantic and Pacific. This industry, called into existence by the arbitrary power of the then ruler of the Continent, and belonging entirely to the present century, has been so widely distributed, and so largely carried out, that its condition is far more advanced, as a scientific manufacture, than that of the extraction of sugar from the cane, which dates some centuries back. In its early days it had much to contend against; our acquaintance with organic chemistry was very

defective—agriculture had necessarily been much depressed by the unsettled state of the Continent—in some countries fiscal regulations obstructed both experiments and improvements. Now, however, these days are past, and it represents one of the most flourishing and most important of all the manufactures connected with agriculture. In Russia, Germany, Austria, Belgium, and France, the farmer is called upon each year to increase his production of the raw material, and science is every day adding to the beneficial consumption of it by the manufacturer.*

In these countries beet is always looked upon as a fallow crop, and is selected as much as possible for the more argillaceous portions of the farm in that part of the course or rotation. Of course there are various modes of growing it in different countries, dependent on the soil, the climate, and the requirements of the markets. In all cases, however, it is considered good farming to let it both *follow* and *precede* a straw crop. In the first case, the stubble of the preceding crop being ploughed in has a mechanical as well as chemical action on the soil, keeping it light and open, and thus more accessible to the influence of the weather during the winter, a matter always of importance on strong soils, but particularly so in countries where the various accessory implements are not so readily obtainable as with us. In the second case, the cultivation necessary to secure a good crop of roots—the deep ploughing, the fine tilth, the hoeing, weeding, and stirring the soil, and the peculiar mode of harvesting, all tend to leave the land in a condition exactly suited to the requirements of a grain crop. In all cases the preparatory tillage and condition of the soil are carefully attended to; the seed is sown as we sow it—sometimes on ridges, but more commonly on the flat—by hand, usually broadcast, or by dibbling. In the most improving districts, especially in France (Département du Nord), a machine is used for sowing it in drills.

The same practice of steeping the seed is found to be advantageous on the Continent as with us; the wrinkled epidermis absorbing sufficient moisture, by immersion for from twelve to

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* In Russia the entire consumption of sugar amounts to 85,000 tons, of which 35,000 tons are made from beet-root.

In Germany (the Zollverein), in 1848 the quantity of beet sugar made was 26,000 tons; in 1851 it had increased to 43,000 tons, the consumption of cane sugar decreasing in the same proportion.

Austria consumed about 40,000 tons of sugar in 1848, of which 3,000 were made from beet-root: this quantity was doubled in 1850.

In Belgium the consumption of sugar is about 14,000 tons, of which 7,000 are made from beet-root, and the number of establishments were nearly doubled in the last year, which, of course, will materially add to the rate of production.

In France, the annual manufacture of beet-root sugar amounts to 60,000 tons, which is about half of the quantity consumed, with an increasing rate of production.

twenty-four hours in water, to enable the germinating process to be set up by the seed much more readily than if it had to rely on the soil for its necessary supply of moisture. This practice, however, is affected by the soil and also by the season. If the soil is of a light porous character, and the weather dry, it would perhaps be injurious to the germinating seed or to the young plant to be thus accelerated in its growth, as without a continued supply of moisture it could not exist; under ordinary circumstances, however, it advances their growth considerably.

In the vicinity of large towns, where the land is generally more subdivided, the facility of disposing of the beet to the sugar factories, and of obtaining a large supply of ready-made manure in return, induces the cultivators to grow the crop year after year successively on the same ground. This system may be carried on for many years with a certain amount of success, but, sooner or later, the bad policy of such a practice is shown by a great deterioration in the crops, both in quantity and in saccharine properties—the one resulting, probably, from the attacks of insects peculiar to the plant, which year after year have been bred in the soil, and increased with each succeeding crop; the other due, probably, to some fungus or vegetable parasite, feasting on the diminishing vitality of a plant debilitated by being grown constantly on the same soil. In 1846 a disease of this character was noticed, both by Kühlmann, in Belgium, and by Payen and Crespel, in France.* The leaves of the plant became withered—reddish-brown spots appeared upon the skin, penetrating the interior of the plant—the flesh became hard and woody—the juice dried up, and showed an *alkaline* instead of an *acid* reaction—and the sugar was viscous, and would not crystallize. The fungus appeared to be very similar to that of the potato disease.

The after operations consist in singling out the plants to certain distances when they are about two to three weeks old—in filling up vacant spaces and carefully keeping the land clean—and in pulling up those which run to seed. Analysis has shown us that the portion of the root exposed to the light contains less sugar than that which is buried; it would therefore be, no doubt, advantageous to mould up the roots after the last hoeing, and thus protect them from it.

In some parts of Germany and in Belgium it is the practice to sow the seed in a separate piece, and thence transplant the young plants to the field. By this method, in North Germany and in Russia, where the seasons are more rigorous than with us, they are enabled to accelerate the time of harvest by fully a month or six weeks, a matter of great importance to the preservation of a root so susceptible of frost as the beet. Köchlin states that it saves

* Annales de l'Agriculture, tom. xvi. (1847).

two months in the ground, and that in ordinary seasons it gives an increased return in the proportion of eight to five.

In Belgium some of the farmers avail themselves of the same practice, and manage to obtain a crop of beet after having harvested a rye or a flax crop. Either of these is ready early in July—the stooks are shifted in the field to get out of the way of the ploughs, which are sent in as soon as the crop is down—the liquid manure carts, conveying the sewage of the house and stables in which rape-cake is dissolved up, accompany the planters, and give a certain portion of their contents to each plant as it is dibbled into the field. All good farmers, whether abroad or at home, agree upon the necessity of keeping their fallow crops at any rate clean: this, carefully attended to, is all that is required between the time of transplanting and of harvest.

The peculiar organization of the beet-root requires great care to be exercised in harvesting the crop, as the slightest injury to it is sure to be followed by a proportionate loss of sugar if intended for the manufacturer, and by a tendency to decay if intended for storing. To the farmer who uses the root for his cattle this is of but small importance as compared with its effect on the manufacturer, as immediately fermentation is set up, the crystallizable sugar is converted into a sweet mucilaginous compound (similar to mannite, $C._6\ H._{14}\ O._6$), which will not crystallize, and is consequently lost. Fine dry weather should be selected for the operation, and especial precautions should be taken to preserve the roots, when stored, from wet and frost. It is always desirable that they should be exposed on the ground for three or four days before they are stacked, in order that they may lose as much of their moisture as possible. This is the more important if they are to be used for sugar making. When stored on the farm the most effectual plan is to select a dry and suitable locality, to pile the roots between two rows of hurdles, set at about 6 to 8 feet apart, and then build them up from the top of the hurdles in a long pyramidal form. A second row of hurdles should then be set all round at a distance of about 9 inches from the others, and the space between the two rows filled up with loose straw, well pressed down; a good thatch should be laid over the centre, the eaves coming well over the outer hurdles. By this method, which permits perfect ventilation while it protects the contents from the severest frosts, the crop may be preserved quite fresh until the end of the season. If the crop is sold from the field to the manufacturer, he generally finds it more convenient to erect permanent storehouses for its reception, in which he can readily secure it from frost and wet.

Our information respecting the action of manures upon the crop is far from satisfactory. In this country, where it is only

grown for cattle feeding, we look more to the general bulk than to the character of any one of its particular constituents. For sugar purposes, however, we must look at it in a special manner, as, to a certain extent, the interests of the producer and the consumer are here opposed to each other. The producer would, of course, like to see as heavy a crop as he could obtain ; the manufacturer cares less about a heavy crop, or even a large amount of crude sugar, than for a crop that shall yield him a pure sugar mixed up with a smaller proportion of the other accompanying ingredients, which always considerably affect the cost of manufacture, and necessarily reduce the amount of crystallizable sugar. In the process of the manufacture a portion of the sugar must always be lost, and this proportion increases with the amount of impurities in the juice. It is important that this should be understood by the producer, so that he might supply the desired variety, and thus meet the interest of the consumer and keep the two departments distinct. On the Continent in many places this has been disregarded, and the consumers have been forced to turn farmers and grow beet for their own works. It would therefore appear that we should endeavour to increase the proportion of sugar without increasing the saline constituents of the crop ; and the heavier our crop obtained under those conditions the better for both producer and consumer.*

Organic manures, if in a proper state, are found to increase the crop ; but soluble saline manures injure the value of the sugar. Thus salt, though an essential ingredient of the plant, acts prejudicially if in too large quantities. At Mannheim a field adjoining the salt-works was planted ; a large crop was produced, but the percentage of sugar was lessened, and the yield was deficient.

Ammoniacal manures increase the bulk, but are found to add so largely to the proportion of organic compounds and water as to render the subsequent operations more expensive.

Boussingault (Economie Rurale) recommends that the land should be kept in good condition by manuring ; and Gasparin (Cours d'Agriculture, t. i. p. 655) states that the growers in the Département du Nord consider that the addition of farm-yard dung increases the bulk of the crop in the proportion of 1·65 tons for every ton of dung applied. M. de Dombasle (Annales de Roville, t. vii. p. 255) upon a poor soil found the resulting increase to be only about half as much ; and M. Crud (Economie de l'Agric., § 255), upon a naturally rich soil (Boulonnais) obtained an increase equal to 2.† Thus we see how little value

* Notes sur un projet d'expérience ayant pour but d'augmenter la richesse saccharine de la Betterave, par M. L. Vilmorin, (Annales de l'Agriculture, tom. xxii.)

† At a recent meeting of the Royal Agricultural Society (April 21st), Mr. Gadesden of Ewell Castle, in describing Mr. Reeve's mode of cultivating sugar beet and mangold-wurzel at Randall's Park Farm, near Leatherhead, stated that his crop

can be placed on results which are affected by climate, soil, and even difference in seasons. In the principal sugar-making districts, however, it is found that by manuring the land either two or three years previous to the beet crop, the greatest number of conditions required by the manufacturer are obtained. This practice is supported by the evidence of Schatten, who found that the expressed juice contained more colouring matter and soluble salts when it came from roots grown on freshly manured soil.*

There are papers on the cultivation of beet and on the results of manuring, &c., by Mr. Miles in the 2nd, by Lord Lovelace in the 4th, by Mr. Pusey in the 6th, and by Mr. Raynbird in the 8th vols. of the Royal Agricultural Society's Journal, which, although bearing but slightly on the present object, may be referred to with advantage.

Section II.

"*Whether mangold-wurzel is applicable to the manufacture of sugar.*"

The field-beet, or mangold-wurzel, is that variety which presents, on being cut open, alternate layers or zones of a white and red colour more or less distinct, and is grown in Germany and France extensively for the purpose of sugar making. It gives a heavier return per acre than the white or Silesian beet, but this latter contains a higher percentage of sugar and a lower percentage of water and of saline matters, a combination of properties which renders it more valuable to the manufacturer. It also is less liable to mechanical injuries, and is less likely to be affected by frost or wet. It is, however, more particular as to climate, and consequently does not succeed so well in general cultivation as the mangold-wurzel, which appears to be grown successfully for the purposes of sugar extraction at all places between 45° and 56° N. lat.

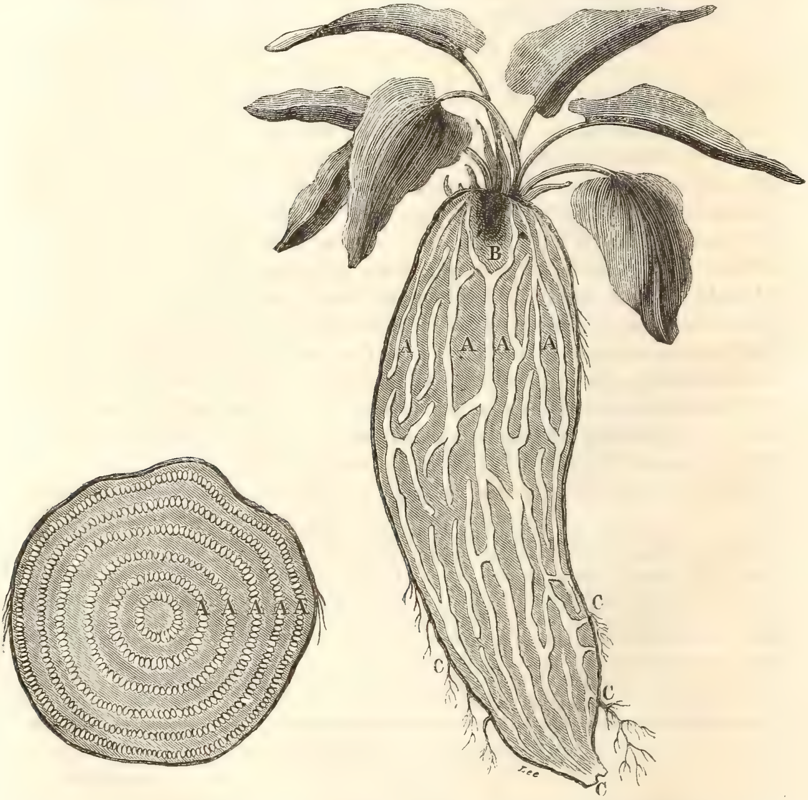
Before commencing an account of the operations connected

last year was 38 tons 16 cwts. to the acre of the former, and 39 tons 13 cwts. to the acre of the latter. Mr. Reeve attributed his success in growing the white sugar beet to his not applying manure *directly* to the crop, and stated that when he had dunged for the beet, the bulbs proved small, and had a large mass of "fuzzy" fibres, and gave but a small weight per acre, viz. from 15 to 18 tons, but that since he had put his manuring matter further off the beet crop, he had raised fine large roots of a great weight per acre.

* The juice was treated with lime and acet. of lead, both before and after filtration, and gave the following results:—

	Before.	After.	
Lime	·169	..	Fresh Manure.
Acet. Lead	1·120	·916	
Lime	·179	..	3rd Year.
	·147	..	
Acet. Lead	·514	·426	
	·686	·502	

with the extraction of sugar from beet-root it may be as well to describe briefly its structure and composition. If we take a root, and cut it down or across, we shall see that it is composed of concentric zones or layers, differing in colour, more or less, according to the variety. The exterior, or skin, is composed of a peculiar compact cellular substance, containing mineral and azotized matter, immediately beneath which lies the herbaceous tissue, containing the colouring matter, an essential oil, and several other peculiar organic compounds; then succeed the concentric zones of vascular and cellular tissue. In the cellular tissue is deposited the saccharine matter, the proportion seeming to be greatest in those cells immediately in contact with the vascular tissue.



A. The zones or layers composed of vascular and cellular tissue, in which the crystals of sugar are contained.

B. The germ, connected by a peculiar tissue with the tap and side roots, and which contains a large proportion of the saline matters, but no sugar.

C. Tap and lateral roots: the latter not necessary, and consequently prejudicial to the yield of sugar.

On dividing the root, and exposing it to the air, zones or layers, shown by dark-coloured marks, may be seen; the cells on either side of these appear under the microscope to contain the largest amount of crystals.

Without enumerating the several substances, some 25 to 30 in number, found in the root, we may comprise them all in the following analysis, which will be sufficient for our present purpose, merely referring to those more prominent ones which affect the manufacturing processes. We will say then that the root consists of (the average of several analyses)—

Sugar	10
Soluble salts, pectin, certain azotized compounds, &c. .	3
Water	83
	96
Woody fibre, insoluble salts, albumen, and other azotized compounds	4
	100

These are mean quantities; in many samples a higher per centage of sugar has been found. Péligot* and Pélouze have both certified that the whole of the sugar is crystallizable: this has been verified by other chemists, therefore it is quite possible to increase the per centage at present obtained in the manufactories. To the able researches of Péligot we are indebted for much valuable information relative to the chemistry of the beet-root, not the least important of which is that the root has the same composition at all periods of its growth, but that the relative proportions of water and other compounds are determined principally by the development and age of the plant, the increase in bulk being due to the increased development of the parenchyma of the cells, rather than to either the number or the size of the cells themselves. Thus, although at one period the entire bulb might be found to contain, say, 10 per cent. of sugar, and at another only 8 per cent., still the actual quantity might be the same, the difference in the per centage being due, not to a diminution in the sugar, but to an increase in the other substances. Hermann also found that the watery character of the bulb increased with its development, which reduced the per centage, or apparent quantity, of sugar. This may be seen in the following Table:—

Percentage of Sugar . .	11·4	9·4	8·5	7·4
Relative weight of Roots .	6	13	23	45

This fact might be applied advantageously in the field, both by affording to the grower an opportunity of harvesting his crop at an earlier period, either to meet the other operations on his farm or to secure fine weather, and also by enabling him to set his plants closer together on the ground, and thus directly increase his returns. Besides the sugar, the azotized compounds and the

* Recherches sur l'analyse de la Betterave à Sucre.

salts are the only constituents to be noticed; these are always present in the juice, and are the great obstacles in the process of manufacturing—the one being the great inducer of fermentation, and both opposing the process of crystallization. These compounds exist in several different conditions; the two principal ones, as far as our object is concerned, are, albumen, which coagulates at boiling point, and is removed in the defecating operation—and another of a peculiar nature, which, when exposed to the air, either in the sliced root or expressed juice, is rapidly oxidized, becoming first red, then brown, and lastly black. The other compounds have no particular action, and seem to be very irregular in their proportions. The salts will be noticed in Section IV.

Section III.

"*Manufacture of sugar according to the latest improved processes.*"

The process of sugar-making from beet-root may be divided into two parts—the extraction of the juice from the root, and the extraction of the sugar from the juice. The first consists of three operations:—

Washing,
Rasping, grating, or slicing;
Pressing, or macerating, according to the process followed.

The second consists also of three operations:—

Clarification or defecation;
Filtration—this is usually performed twice, the syrup being partly evaporated before the second takes place.
Crystallization.

Washing.—The first operation is to thoroughly cleanse the roots of any foreign matter in the shape of soil, stones, or manure that may be attached to them. This may be effected by a machine similar to that used for washing potatoes—Crosskill's is perhaps the best—care being taken that the water shall be changed as often as may be necessary. This is an important point to attend to, on account of the subsequent operations of rasping and pressing—the first of which would be prejudiced by any stones or grit remaining attached to the root, while the other would be affected injuriously if the expressed juice or liquor were tainted by any organic matter remaining after the washing. The process of rasping is now always preferred to either crushing or slicing the roots, the great object being to break up all the cells in which the sugar is deposited, and this is effected in a greater proportion by the rasp than by any other process. The form of the rasping-machine should be cylindrical, and arrangements should be made that the roots are supplied to it *regularly* and with a slight pressure, so that they may be kept in constant contact. Practice has shown that the higher the speed at

which this machine is driven, the finer and more pulplike will be the particles removed, consequently the cells will be ruptured to a greater degree, and a higher per centage of their saccharine contents rendered obtainable. From 800 to 1000 revolutions in the minute is the speed at which they are driven in most of the large establishments. It is found that sometimes the teeth of the rasp will become blocked up by small particles of the root, and then, owing to the rapidity of rotation, will pass over fresh surfaces without biting them: to obviate this a small jet of water is allowed to trickle over the cylinder, which keeps it clear of such impediments, and mixing with the pulp, falls down into a vessel placed beneath to receive them. The water, in this instance, performs a double service, as it not only keeps the rasping surface true, but by a peculiar physical action, termed "*endosmose*," it extracts a fresh portion of sugar from the pulpy mass, and thus renders the expressed juice of greater value.

Having now reduced the mass into a condition suitable for the next operation, that of separating by pressure the liquid from the solid parts, some points of importance present themselves. The usual mode of effecting this separation is by enclosing the pulp in stout woollen or flax bags, and submitting it to hydraulic pressure. Practically, it is found that a circular shape is the best for these bags, as the pressure is more equally dispersed, all the particles being driven from a common centre, and there are no corners. It is found also that the bags should be at first submitted to a very slight pressure only, so that the juice, which is very abundant, may have time to drain off. In this way several bags are piled on each other, a perforated or channelled metallic plate being placed between each; then a force, small or great, as may be desired, is applied to the top, and transmitted through the entire column. When the drainage is completed, they may be submitted to a higher pressure, which should be gradually applied at first, and increased more rapidly towards the end of the operation. After remaining in the press, say 10 to 20 minutes, the pressure should be removed, and the bags reversed so that their points of contact be changed; the machine should then be again put in action, and its highest power applied. By the first, from 30 to 40 per cent. of the juice is obtained, and by the two last pressings from 40 to 45 per cent. more; about 80 to 85 per cent. in all. As the pulp in this state contains all the elements and conditions necessary for fermentation, which would materially affect the yield of crystallizable sugar, it is considered advisable to dip the bags, between each part of the operation, in a weak solution of *tannic acid* (2 to 3 parts in 1000), which combines with the azotized principles of the external surface in contact with the air, and prevents their change. In the case of

warm weather, or of any portion of the roots being injured, this precaution is doubly necessary. Such is the ordinary way of extracting the juice from the root. In some places the bags are again immersed in water (containing tannic acid), and again submitted to a high pressure, by which from 5 to 10 per cent. more of the juice may be obtained. There are other methods of treating pressed cake, in order to obtain the remaining portion of its saccharine contents; but it is admitted practically that, under the most favourable conditions, from 5 to 10 per cent. of the juice, = to 1 per cent. of sugar, are lost, or rather are left in the cake. These methods are based upon the ordinary arrangements of beet-root cultivation, which requires that, at a certain time of the year, the roots should be removed from the soil, and then either used in a fresh state, or stored away in such a manner that they shall remain uninjured and unaltered until they are required in the manufactory. This necessitates either a very large amount of stowage room with all its risks and expenses, or else that the work should only proceed during a certain period of the year, both of which points are matters of serious importance to the proprietors.

To meet these objections, Schützenbach, a German chemist, proposed that the fresh root should be at once sliced up into thin pieces, and then desiccated at a certain temperature, by which not only would all, or nearly all, the water be driven off, and thus considerably reduce the weight and bulk of the mass, but also the albuminous compounds would be coagulated, and in that condition rendered less soluble, and at the same time less liable to any subsequent fermentation. This method has been carried out extensively in Germany, at Ettlingen, for some years past, and has more recently been adopted by one of the first French makers at Valenciennes.* In these establishments the root is cut up into cubes or parallelopipeds, and from 80 to 84 per cent. of water is evaporated, leaving only from 16 to 20 per cent. of dry matter. It is found practically advantageous to sprinkle the cut roots with charcoal or with lime in fine powder, in order to check the tendency to fermentation, which is set up immediately the cells are separated. Of the two lime is the best, as it also neutralizes any organic acids which may be formed. It is also necessary that they should be removed as speedily as possible

* In a communication from M. Paul Hamoir (Serret, Hamoir, Duquesne & Co.), we are informed that the practice followed in their establishment secures a more certain yield of sugar, as the roots are used when their saccharine properties are in their highest development. If they are taken from the field, and stored even under the most favourable conditions, the quantity of crystallizable sugar is found practically to diminish according to the time they have been kept. For instance, if the fresh root yielded in October 7 per cent. of sugar, in January it would only give 5 per cent., and in February probably less than 4 per cent.

to the drying-house, which may consist of a series of wire trays or shelves, or any similar arrangement through which a current of dry air, of not less than 100° and not more than 150°, should be passed. When quite desiccated they may be stored away as they are, or reduced to a coarse powder, and will thus keep unaltered for any time until they are wanted in the factory. For use they must be ground, and the coarse powder be then macerated in about 36 parts of boiling water, in which Schützenbach recommends from 2 to 3 parts of sulphuric or sulphurous acid should be mixed. It is generally arranged that the dried powder shall be placed in a range of vessels of different levels communicating with each other, so that the water shall pass through the uppermost, and dissolve out its contents previous to passing on to the next. In this way a clear and more concentrated syrup is obtained, thus effecting a great saving in the fuel and risks consequent on the evaporation. This method (Schützenbach's) has been condemned in many districts, on account of the increased expenditure required in buildings for the drying operation, and in the fuel necessary for the evaporation of the 36 parts of water subsequently added. In this country, where fuel is so cheap, and where desiccation on a large scale is so constantly employed in manufacturing concerns, these objections, probably, would not have much weight.

We must now consider the various operations forming the second part of the process. After having obtained all the available saccharine juice from the root by one of the foregoing methods, the next operation is that of clarifying or defecating. To effect this, several modes have been devised. The only one which we think, however, necessary to give here is the lime process, which is the simplest, the most general, and the most readily understood and carried out.* The juice is placed in a large pan (metal), heated by steam in the usual manner, and evaporated down to a certain specific gravity; a certain quantity of hydrate of lime is then added, and the boiling continued until the whole of the changes effected by the lime have taken place. These changes are most important. The lime, uniting with the albuminous and gummy matters, forms insoluble compounds with

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* The process due to M. Melsens, in which acid sulphites, and more especially bisulphite of lime are employed, is adopted in some districts on the Continent. These salts effect a double purpose, checking fermentation by the presence of sulphurous acid, and neutralising the sulphuric acid as fast as it is formed by means of the lime. (See Phil. Mag. 1850.)

A process very similar in its action was patented in 1849, by Messrs. Price and Reece, which includes the application of both acid sulphites and hyposulphites. (See Repository of Patents, No. 85.)

In 1849, Messrs. Oxland patented a process for defecating and decolorizing sugar, by means of acetate of alumina, &c.; and in 1851, they took out a second patent for the use of phosphoric acid in a state of combination with certain alkaline bases for the same purpose.

them; the free organic acids are neutralised; and, consequently, all the salts held in solution by them (malates, phosphates, &c.) are precipitated, most of which, save the alkalis, are decomposed, and insoluble salts of lime formed: the fatty and colouring matters, to a great extent, are also destroyed. If an excess of lime be left, it combines readily with an equivalent of the sugar, and forms a distinct compound, which is afterwards decomposed in the decolorizing operation. Achard recommends that this excess of lime should be at once taken up by sulphuric acid; this compound is, however, by many considered to be more prejudicial to the sugar than the other compound. Kühlmann, instead of sulphuric acid, takes up the excess of lime by carbonic acid. The various compounds resulting from the mixture of lime with the juice at a high temperature, are removed either in the shape of a scum from the surface, or by decanting the clear syrup from the dregs occasioned by the precipitation of those that were insoluble. In boiling, the liquid should be of a clear yellow colour: if the boiling commences in the middle before the sides, it is considered a bad sign; and the scum should be thick and tough, and full of irregular fissures. The refuse of the clarifying pans of one of the large factories, at Magdeburg, was examined by Schmidt, who found it to consist of albumen, azotized matters resembling gelatine, others resembling humus, a soap formed of lime and fatty substance, oxalate of lime, phosphate of lime, sand, &c. It is very desirable to ascertain, as near as possible, the proportion of lime to be added to the juice; as, although an excess does no direct injury, it may occasion some loss in the produce. However, this must in most cases depend upon the condition of the syrup, whether it is made from perfectly sound roots or not, and the period of the season. If the roots are sound and fresh from the soil, then less lime is required than if they had been at all injured, or stored away for any time. In the former case, about 3 to 5 parts of lime to 1000 parts of juice are sufficient; in the latter, from 5 to 10 parts to the 1000, according to the requirements of the case. Some care is needed in the preparation of the lime, which must be carefully slaked (hydrated) by mixing it with about 10 parts of boiling water, and then passing it through a fine wire sieve, so that all impurities and lumps may be separated. When the clarification is completed, the syrup is removed as hot as possible to the filtering-room, where it is passed through layers of animal charcoal in the ordinary way. This operation is usually repeated, the syrup being evaporated to a greater density previous to the second filtration.

These two operations remove any impurities that may have passed from the clarifying pans, the excess of lime, and all the colouring matter of the syrup. The only portion of the process now left is to concentrate the decolorized syrup, and then run it

into moulds to crystallize, and thus be rendered fit for market. This is a very simple operation, and is so largely carried out in the refining of cane sugar in this country that it needs no further description than that the points to be attended to are the regulation of temperature of the boiling-pans, and the density at which it is run into the pots or moulds. The larger portion will assume a solid crystalline form; the remainder, which consists of sugar partly altered by oxidation, termed molasses, and holding in solution the alkaline salts, is left to drain out from it slowly, or may be drawn off by mechanical means.

Section IV.

"*Disposal of the refuse for the distillation of spirits, extraction of salts, or feeding of cattle.*"

We have now obtained from the original root three distinct substances—the solid pulp for cake, the manufactured sugar, and the molasses or refuse. The first comes from the presses in the shape of a hard, solid cake, usually equal to from 15 to 20 per cent. of original bulk or weight of roots employed. It is of a nutritive character, and is well adapted for cattle food, for which purpose it is largely consumed. We are not aware of any direct analysis of it; but, judging from the composition of the root, and of the matters abstracted by pressure, we may form a tolerably accurate estimate of its real value. The sugar itself forms the staple article of the process. The molasses, which formerly was considered of so little value as either to be given to the pigs or else used for making a soluble colouring matter, has latterly been examined more scientifically, and found to contain substances worthy of more attention. It is now mixed with water, slightly acidulated with sulphuric acid, and submitted to fermentation, and a large proportion of alcohol obtained by distillation in the usual way. The molasses usually contains about half its weight of sugar, and in that condition would yield about 30 per cent. of pure spirit. There then remain water, organic matter, and salts; the former is evaporated, and the latter are either ground up together and used as a manure, or else they may be separated, either by dissolving out the salts, or by incineration, which of course destroys the organic matter.

The quantity of saline matters varies according to the variety of root used; an average would perhaps give 8 to 12 per cent. of the weight of the molasses. They are found in the following proportions:—

*Sulphate of potassa . .	7 to 11	per cent.
Carbonate of potassa . .	17 to 20	,,
Chloride potassium . .	27 to 45	,,
Chloride sodium . .	25 to 34	,,
Cyanide potassium . .	traces.	

* Knapp, Chimie Technolog.

Analysis shows that the per centage (·89) of mineral matters in the root is very small, and even of this certain portions remain in the pulp or cake, and in the clarifying pan; therefore the proportion of saline matter obtained from the molasses must be very small in comparison with the bulk of roots used. It is, consequently, customary, after evaporating the residue of the distillation to dryness, to leave it in that condition until a sufficient quantity has been obtained to economise the extraction and separation of the salts. At Waghausel, where about 30,000 tons are annually consumed, they obtain about 200 tons of salts in the foregoing proportions; at Valenciennes (Serret, Hamoir, and Co.) the consumption and return are about double that amount.

Section V.

"*Comparison of profit per acre from production of sugar or corn at present prices.*"

We find some difficulty in determining the manner in which this section should be considered, as "the comparison of profit per acre from the production of sugar or corn" is in fact a comparison between the profits made by a manufacturer and those by a farmer.*

* We have some valuable information bearing upon this point, in the Report of the "Commission spéciale sur les Cultures de MM. Crespel à Arras," published in the "Annales de l'Agriculture" for 1850. Messrs. Crespel are not only manufacturers of beet-root sugar upon a large scale, but also cultivate extensive farms, for the purpose of growing their own supply, occupying in all 1519 hectares, (about 3750 acres), and manufacturing 2,500,000 kilos. (about 2500 tons) of sugar.

It appears that they farm chiefly upon a 5 years' rotation, and that their land is thus divided, (1849)—

Hectares	310	always in mangold-wurzel, owing to peculiar conditions.
,,	17	permanent grass.
,,	368	in wheat.
,,	101	in oats.
,,	55	in rye.
,,	484	in mangold-wurzel.
,,	176	in leguminous plants, clover, sainfoin, &c.
,,	8	in potatoes.
	1519	

The average produce of the mangold-wurzel is 35,000 kilos. per hectare = to about 14 tons the acre, and the average selling price is 18*s.* the 1000 kilos. = to 15*s.* per ton.

The wheat (English variety) yields 45 hectolitres per hectare = to about 50 bushels the acre.

The common wheat (blé du pays) only yields 25 hectolitres per hectare = to nearly 28 bushels the acre.

The average of entire crop (1849) was 32 hectol., or about 35 bushels to the acre.

The straw averaged 6000 kilos. per hectare = $2\frac{1}{3}$ tons to the acre.

Taking these averages, and assuming the value of the wheat to be 5*s.* per bushel, and the straw to be 20*s.* per ton, the money return for the two crops would be about the same, the advantage to the grower being that of having the tops of the mangold-wurzel left behind, either for feeding purposes or as a manure. The Report however states that these returns, both in grain and in straw, are about one-third higher than the ordinary returns of the district.

However, as the whole question relates more to *technical* than to *pure* agriculture, we will endeavour to meet what appears to us to be the intention of the proposers, by giving the respective cost and advantages of the two crops. The question of the cost of the manufacture of the sugar is so differently stated by different authorities, and so difficult to be arrived at from the manufacturers themselves, that in order to save error we only propose to give the various products and their market values; from which can be deducted the expenses of manufacture according to the evidence selected.

So far our information has led us to believe that, for the production of a crop of beet for the *purposes of sugar-making*, it is desirable that the land be of good quality and in good condition; but that it is not desirable that any manure should be applied immediately preceding it. We know also that it is not generally considered good farming to take a wheat crop from fresh manured land, but rather to take a root or forage crop, and then the corn the year after. It will therefore save trouble, and probably much difference of opinion as to details, if we assume the soil for the two crops to be of equal value and in equal condition: their cultivation would then stand thus:—

Mangold-wurzel.	£.	*s.*	*d.*	*Wheat.*	£.	*s.*	*d.*
Tillages . . .	1	19	0	Tillages . . .	0	14	6
Seed . . .	0	3	0	Seed . . .	0	10	0
Harvesting . .	0	6	0	Harvesting . .	0	6	0
	2	8	0		1	10	6

The average crop of sugar beet on the Continent is, in the best districts, about 15 tons per acre.* We might in this country expect to grow rather more—say 20 tons to the acre, under favourable circumstances; and on land of that quality we might expect to see 5 quarters of wheat grown. Therefore the return of the two crops would be, for—

Mangold-wurzel.	£.	*s.*	*d.*	*Wheat.*	£.	*s.*	*d.*
20 tons of roots, at 15*s.* .	15	0	0	5 qrs. of wheat, at 48*s.* .	12	0	0
3 tons of tops, at 10*s.* .	1	10	0	1½ ton of straw, at 25*s.* .	1	17	6
	16	10	0		13	17	6

If the expenses are deducted from each, it will leave a nett return of 14*l.* 2*s.* for the mangold-wurzel, and 12*l.* 7*s.* for the wheat crop.

* M. Hamoir states that they cultivate mangold-wurzel extensively, and that they average a crop of from 40,000 to 50,000 kilos. the hectare = to 16 to 20 tons the acre, according to the season; and that they can purchase their supply at from 14*s.* to 15*s.* per ton.

We ought, however, to bear in mind that the corn crop usually occupies the soil for an entire year, and that the root crop is sown in April or May, and is taken off the ground in October or November, at latest; thus offering to the farmer an opportunity of having some early keep, or even a crop of peas or early vegetables, if he live in the vicinity of a large city, and is disposed to follow the continental practice of transplanting his mangold-wurzel from his raising-beds to his fields. At the same time we must recollect that the extra expenses of tillage are not entirely lost: the long tap root of the mangold-wurzel seeks its food far below the line of ordinary cultivation; in harvesting this is broken off and left in the soil, and the act of pulling up the crop occasions a disturbance of the soil, which is advantageous to the succeeding crop. In topping, cleaning, and trimming the roots, too, a large quantity of organic matter is left on the field, which must in its decay assist in fertilising the soil.

If we look at the relative amount of mineral matter removed by the two crops, we shall find that, although the one removes a bulk of 23 tons, and the other only a little more than 2½ tons, their mineral constituents differ but slightly in weight—the one being about 398lbs. in the roots and 105lbs. in the leaves per acre, and the other about 365lbs. per acre. If the mangold-wurzel is used for the purpose of sugar-making by the grower of it, then the *whole* of the mineral or inorganic matters would remain on the farm, as the substance abstracted (the sugar) is composed entirely of organic elements, which are all derived from the atmosphere.

The following analysis of the mangold-wurzel will perhaps be of service in estimating the real chemical value of the crop:—

	Tops.	Root.
Silica	1·99	2·57
Phosphoric acid	5·15	3·08
Sulphuric acid	5·8	3·37
Carbonic acid	6·49	18·32
Lime	8·65	1·95
Magnesia	8·66	2·11
Peroxide of iron	·96	·6
Potass	21·26	24·79
Soda	7·01	13·75
Sodium chloride	33·96	29·41
Per centage of ash	1·7	·886*

The leaves of the plant also appear to possess a far higher value, both as a *feeding* and as a *manuring* substance, than we are accustomed to assign to them. Boussingault (Annales de Chimie) gives us an organic analysis of the roots and the leaves of the plant; a comparison between their respective compositions

* Way, in the Royal Agricultural Society's Journal.

will be very much in favour of the leaves for the purposes just mentioned. The substances were dried necessarily, previous to analysis. Their proportions of water were about the same, and their elementary composition was as follows:—

	Root.	Root.	Leaves.
Carbon	42·75	42·93	38·1
Hydrogen	5·77	5·94	5·1
Oxygen	43·58	43·23	30·8
Nitrogen	1·66	1·66	4·5
Ash	6·24	6·24	21·5

thus showing that, in a chemical point of view, the leaves *were three times as valuable* as the *same weight of roots* would be.

Thus much for the agricultural part of the question; the manufacturing we will leave for the reasons already given. We may, however, assume that, under fair management, the root will yield 6 per cent. of sugar;* the crop of 20 tons would then be disposed of as follows:—1⅕ tons of sugar at, say from 26*l.* to 32*l.* per ton; 3 tons of cake (the pressed pulp) at 2*l.* per ton; 8 to 15 cwt. of residue, containing alkaline salts, organic matter, and sugar, which latter is convertible into alcohol to the extent of 1-3rd of its own weight.†

In taking a résumé of the foregoing, it would appear that—

1stly. The cultivation of beet for sugar making leaves the whole of the mineral matter free to be returned to the soil, either in the shape of a direct manure, or in the shape of a nutritious feeding substance for cattle.

2ndly. The plant obtaining its food from the atmosphere, and by means of its long tap-root from the soil at a depth below ordinary cultivation, would not injure the succeeding crop, but would have a tendency to enrich the surface-soil by elaborating mineral matter from below and bringing it up to be applied on the surface.

3rdly. It offers opportunities to the grower to make other use of his land for, say, 6 months out of the 12, which in many cases would be productive of great pecuniary benefit to him; it also enables him to select his own time for harvest, without any sacrifice of the valuable principle of his crop.

In conclusion, we must acknowledge that the departments of production and consumption appear to us to require distinct consideration, and could not be carried on beneficially by the same individual, unless under peculiar circumstances.

* Messrs. Serret, Hamoir, & Co. consider that 6 per cent. of fine sugar is a satisfactory result: the last year being a favourable one, they obtained 7 per cent.

† Sullivan gives sugar at 28*l.*, cake at 2*l.*, molasses at 2*l.* per ton.

The producer generally has neither the capital nor the knowledge required in such a manufacture; neither could the manufacturer, on the other hand, supply himself entirely, even were he to invest a portion of his capital away from his own special calling. He, no doubt, could and would farm well; but in order to keep his machinery in motion, he would require the produce of an entire district. Apart from all manufacturing calculations, it would appear to us that the establishment of such a manufacture would be productive of benefit to the district, inasmuch as a ready market would be obtained for a paying crop,—an improved system of agriculture would be generated in order to meet the demands of the consumers,—and the successful application of science in the factory would probably lead to its more general introduction in the field.

VII.—*On an Improved System of Irrigation.* By John Bickford, Crediton, Devon.

After nearly twenty years' experience of this system of watering meadows in different situations, and under nearly every variety of circumstance, I may without presumption judge of its value; and being confirmed by the experience of my neighbours, whose opinions are entitled to respect, I venture to offer it to the consideration of others, believing that the use of this system would have the general effect of improving irrigated meadows in yearly value from 10*s.* to 20*s.* per acre. I am confirmed in this opinion by long experience, strengthened by the estimate made of it by a few agriculturists who happen to have had their attention drawn to it—persons well qualified to judge of such a matter.

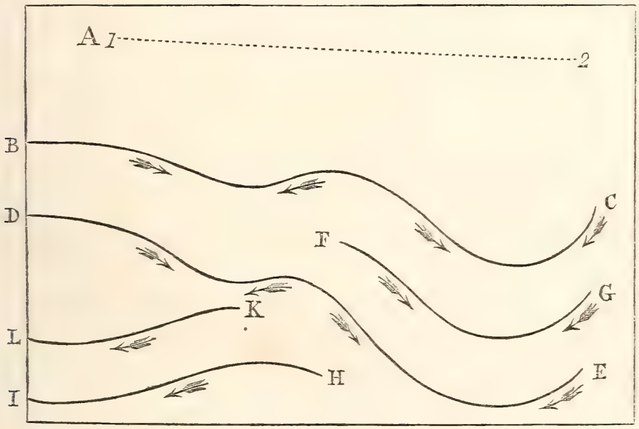
This system has the advantage over the common system of obviating the necessity for large and frequent level gutters; it has the effect of continuing (and even causing) a smooth and uniform surface to the meadow, allowing of the operations of mowing and carting over the meadow without any sensible perception of the existence of the gutters used for irrigation; and also, that of accelerating the speed of the water over the land when "turned on," and the speedily draining the water from the surface when "turned off." In fact, it becomes an instrument in the hands of the irrigator, by means of which he can do with ease whatever his judgment determines ought to be done. It also obviates that waste of land occasioned by the usually large gutters. In fine, I profess to say that it is every way better than the old system: it can be done in half the time, and for less than half the expense.

Without further preface, I shall proceed with the details of the plan, and shall endeavour to make it quite intelligible. The

chief features of the system consist in causing the ground intended to be irrigated, to be covered with a net-work of small gutters, intersecting each other as nearly at right angles as circumstances will permit. These gutters are about 4 inches wide and 1 inch deep; they are cut with a "*die*," fixed in a sort of plough of simple construction, drawn generally by one horse. This net-work of gutters is fed at the highest level possible, or thought desirable, by a carriage gutter of sufficient size for the purpose, to be determined by the operator.

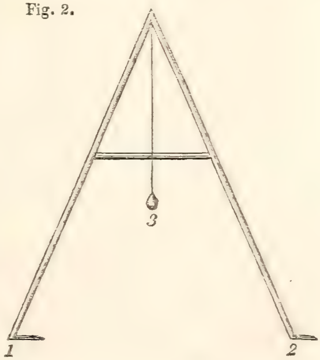
The system will be fully brought to view in the course of the description I shall give of the manner to be pursued in laying down the levels.

Fig. 1.



Let fig. 1 be a piece of meadow; look first where the water enters the meadow, or where it *can be made* to enter. This is a matter of some importance, and should be considered well, in order to get the best supply of water, at the best place, and at the least expense. Let this be ascertained to be at A in figure 1. Then estimate roughly where it may be supposed the water will run; suppose along the dotted line 1 . . . . 2. Then take the level (fig. 2), and proceed to mark a line across the meadow, according to the following rule. Stand the feet Nos. 1 and 2 (fig. 2) level on the ground by

Fig. 2.



means of the plumb-line 3; mark the place of No. 1; then advance the level by putting No. 1 in the place of No. 2, and finding a new place for No. 2 by means of the plumb; and so proceed until you have made a level line across the meadow, subject, however, to certain variations, which I shall explain as occasion may require. Let some person follow with a spade or something of the sort, and turn up a bit of sod at every alternate move of the level, by which means you will have a bit of sod as a mark, at about every 10 feet. Begin say at B, fig. 1, and proceed as directed, and on a flat piece of ground you will probably produce a line thus, B C. The arrows marked on the line show the way the water is to be made to run on in the gutter line; to obtain which you must deviate from precise levelling, and allow the plumb-line to drop a little before the level mark when you are inclining *down* the meadow, and a little behind it when you are inclining *up* the meadow. This will have the effect of running the water *out* of the *low* places, and *upon* the high places. Care must be taken in levelling to follow out the indications of the level, however crooked and curved the line might appear; and by all means to go *down* around *every* elevation, and to avoid every disposition to cut the line straighter, &c., as every straight cut that is made of that sort will have the effect, more or less, of causing a dry spot below the gutter, or a pond above it.

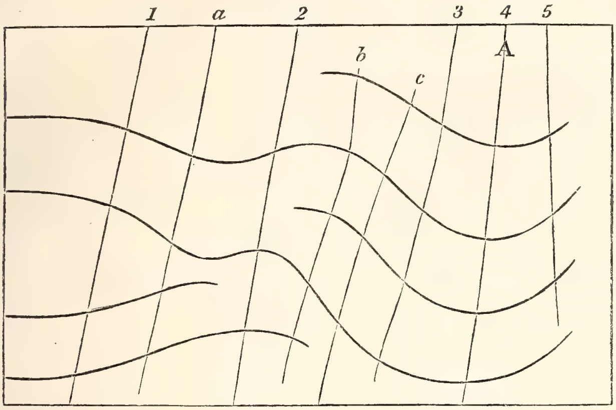
Having completed that line, return to the side you first began, and by no means level backwards. Return, say to D, which should be about 10 paces down from B; and by proceeding as in B C, you will very likely produce the line D E. The consequence will be, that C and E are too far asunder; you must therefore begin at F, and produce the line F G. I have supposed the middle of the meadow to be lowest, and the meadow itself to be *flat*, rising on each side of the middle by two gentle undulations, requiring the lines of gutter to curve very considerably. The nature of the ground is supposed to make it necessary now to begin at H, and to produce H I. It will now be perceived that D and I are too far asunder, making it necessary to introduce K L, beginning at K. Then proceed to finish out the higher side in like manner.

To avoid crowding the figure, I shall draw it anew, with a few alterations introduced for the purpose of showing the next process to advantage.

Let fig. 3 represent a meadow, with all the lines of fig. 1 marked with the level and ploughed, but not "turned out;" the lines will be sufficiently perceptible to manage the next proceeding. It will be perceived that the curves of the lines form a series of loops, and that the undulations of the meadow are

prettily mapped out by the curves going *down* around the hills and *up* around the valleys. You can at once perceive where the

Fig. 3.



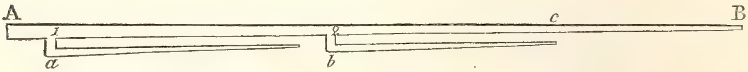
water is principally wanted, viz., just above where the curves form the greatest downward bend. In the case before us it is at A, fig. 3. The next thing to be done is, to draw the lines which, upon an average of the whole, will be at right angles to the level; but in each particular line will deviate from the right angle, more or less, according as the ground is more or less irregular. The plan I adopt is, to put some one to plough after me, and then I walk on before, and, by dragging my feet, leave a sufficient stain to mark where the plough must follow. Care must be taken to go as nearly through the centre of the downward loops as possible. In order to do this, first cut the lines 1, 2, 3, 4, 5, and then fill up the intervals by cutting *a*, *b*, *c*. They should be from 10 to 15, or more, paces apart, according to the taste of the operator. I do not at all like them to be farther apart than 15 paces, but some persons think that by placing them closer together you cut too much land.

The next business is to bring in the water, after just lifting the turf out of the gutters already cut. I use, first, a spirit level, and set a mark every 2 poles, allowing the gutter to drop $1\frac{1}{2}$ inch or 2 inches if the nature of the ground will allow of it; but not less than $\frac{1}{2}$ inch will do at all well. A much larger gutter is required at $\frac{1}{2}$-inch drop than at 2 inches, and, besides, it will not run itself dry so well when the water is turned off. The 2-inch drop gutters will run the water off directly; the $\frac{1}{2}$-inch will scarcely do it at all. Regard must be had to the supply of water required at the farther end. In the case supposed in fig. 3, it is wanted on the rising ground, at the farther end A; therefore

the gutter should drop that way accordingly (and in proportion), and be of a good size; but if the water is wanted chiefly at the beginning end of the gutter, the drop need not be so much, and the gutter should taper away so as to end nearly in a point.

The next consideration should have regard to the size of the stream. If it is enough to water the whole piece at all times, one gutter, of sufficient size to do the work, should be made; and to do it without stops; stops in a gutter are decidedly objectionable. Where the stream is small, make a leading gutter, and take out from it taper gutters, each of a size suited to the stream when at its smallest, so that when the stream increases (from rain or any other cause), so many taper gutters may be used as will disperse the whole stream. The leading gutter should continually decrease in size from the beginning to the end, *i. e.*, from the place where the first taper gutter is taken out of it, and finish in a tapering water-gutter itself at last (*see* fig. 4).

Fig. 4.



A B is a carriage-gutter as far as *c*, and a watering gutter from *c* to B: *a* and *b* are watering gutters taken out of it. When the stream is small, a stop at 1 will cause it to work in *a*; a stop at 2 will work in *b;* without any stop it will work in *c* B. If the stream is too much for *c* B, it will work *b* at the same time; and should there be water enough, it will also fill *a* without any stop at all. Care should be taken not to make A B larger than just to carry the full stream wanted; and in every case when the gutter is got too large by frequent cleaning out, cut it anew on one side or the other.

In levelling, after having marked every 2 poles with the spirit-level, mark the ground between with the plumb-level every 10 feet or so, and cut accordingly. Make the hedgetrough a carriage-gutter wherever it can be done conveniently, taking care always to make the water *run* in them when so used; and by no means to have stagnant water in the troughs. Covered gutters made with large tile could also be substituted for the deep open carriage-gutter, where it is necessary to cross the middle of meadows; it would thus obviate the danger of the open gutter to sheep and lambs; and the extra expense would be partly compensated, as the tiled gutter would never require the annual "*cleaning out.*"

General rules cannot be laid down to suit every circumstance that will occur, but practice and an ingenious mind will decide that which is most fitting on each occasion.

In watering with a small stream which happens to be insufficient for the whole meadow, the water must be confined to ground determined on by stops in the two perpendicular gutters which run on the two sides of it, thus :—

Fig. 5.

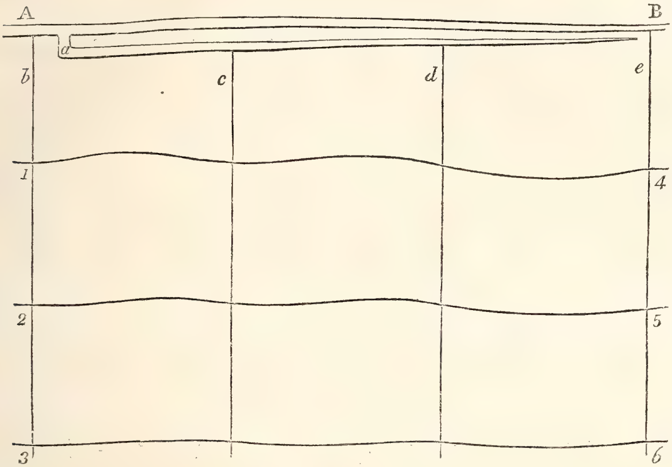
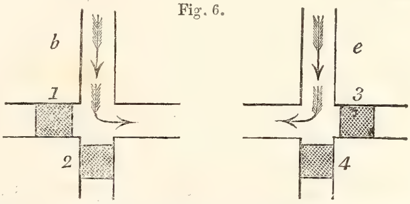


Fig. 5 is a section of the net-work of gutters; A B is the carriage-gutter; *a* is a taper watering-gutter, to the extent of which the water is supposed to be determined to be confined; *b*, *c*, *d*, *e*, are the feeding gutters (perpendicular to the levels); the cross-gutters are the "level" ones; *b* and *e* serve as the two side gutters of the proposed section to be watered. The water is confined to the ground between them by stops at the crossings, arranged thus :— *b* is a crossing on the feeder (*b*, fig. 5); and *e* is a crossing on the feeder (*e*, fig. 5); 1, 2, 3, 4, are stops, the purpose of which is obvious enough. The arrows show the direction the water is made to run. The stops are pieces of the turf taken out of the gutters, which, being cut with a "*die*," of course fit the gutters with exactness; by this means *any* stoppings that may be required are done instantly, without any trouble or loss of time.

Fig. 6.



The gutters are not to be cut in the same places two years following, but on one side as near as can be conveniently done, say about a foot and a half from the former ones; and the turf

of the new gutter used to fill in the old one, taking care *not* to cram the old gutters too full. By this means the gutters are always new and always the proper size. If cut on the *right*-hand side and *above* one year, the next year they should be cut the *left*-hand side and *below;* thus they will always retain their original position, and be as efficient at any future period as they were the first year they were made.

The objection generally raised against this plan is, that the only carriage-gutter being at the head (highest level) of the watered ground, the best of the water is expended on the first part of the meadow (which is generally the best and healthiest land), and the lower part of the meadow (which we have said might want it most) is irrigated with the water after having been deprived of its best material. Such an objection is more plausible than valid; experience constantly denies that such is the result. I have always seen the lower parts of meadows formerly on the old system improve when put under this system, for however gutters on the old system might be *provided* for carrying the water down to a certain place, the machinery is so cumbrous that it is seldom used. I mean, there are so many heavy *stops* and *bays* to be interfered with, to be removed, adjusted, put in and readjusted, and so on, that it is seldom undertaken—seldom or never used. What is wanted is a machinery that can be used readily—with pleasure and not with difficulty. The plan I advocate is just such a thing; it is easy to use, and, therefore, pleasant to do; and, for that reason, sure to be done. And I shall presently show that it is quite effectual for the purpose even of carrying the water fully charged with matter in solution to the extreme distance desired.

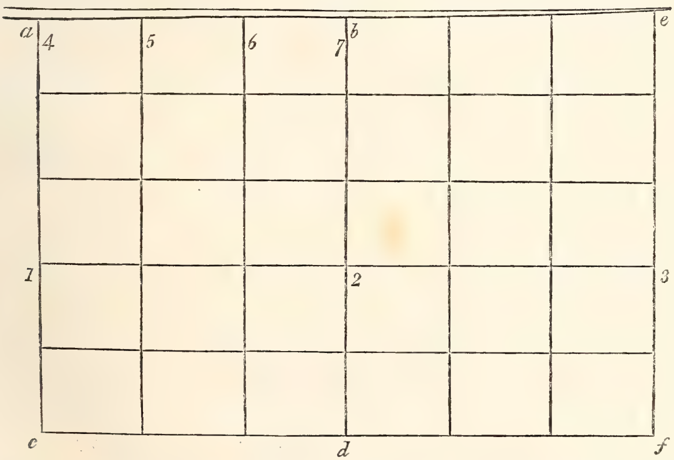
In the first place, I must admit that the stones, gravel, grit, and even sticks and leaves with which a stream might be charged in case of flood, would not be carried to the extreme end of a meadow by the means I employ; but then I say they *ought not;* and I may add, in the case of the old plan, they *are not;* for although gutters are cut ostensibly for the purpose, they never answer to the effect of carrying the *heavy* material. This is much better than allowing violent gushes of water to create a number of artificial hills and gullies in the usual way. It is well known (to those who know practically anything about it) that, when water is allowed to descend a gutter in a full violent stream, it frets the earth away from the sides and bottom of the gutter, and the material is washed down to settle when the current ceases to rush, thus causing two unsightly evils—a deep gully in one place, and an inconvenient hillock in another.

It will be proper now to call attention to the manner in which the water is carried, with its suspended matter, to the extreme end

of the meadow, by the plan we are pursuing. You will observe that the ground is covered by a sort of net-work of little gutters, from the "leading-in" gutter at the head to the extreme end of the piece of ground lying *downward* from *that leading-in* gutter; one set of gutters as we have shown being, in a sort, parallel to each other, intersected by gutters at right angles to them, and also parallel to each other: this would be strictly true were the surface strictly a plane surface; but this being very rarely the case, both sets deviate from a strictly parallel condition (as we have shown) in order to meet the undulations of the ground; these deviations compensate each other on the aggregate. Now, instead of carrying the water "down to the lower end" by means of one large gutter, and then dispersing it by another large gutter (a level one), we do it by twenty or so little gutters which feed the dispensing gutter about every ten or fifteen paces; being so small they never fret away; being newly cut every year they never increase in size. These advantages are too manifest to require pointing out.

The sections for watering on our plan are perpendicular sections (I call them so for want of a more appropriate term), *i. e.* from the "leading-in" gutter to the end of the *piece*—the *running* way of the water; and *never lateral* sections. That is, our section will be (*see fig.* 7) *a*, *b*, *c*, *d*, for one section, and *b*, *e*, *d*, *f*, for another; thus:—

Fig. 7.



and never 1, 2, 3, *c*, *d*, *f*. The water is not impaired in quality while running down these upright gutters, 4, 5, 6, 7.

We see the reason of this while we keep in memory that water is only good (as water) from two circumstances, viz. 1st, from

the purity of its composition (freedom from mineral properties), in which case the water will be as good at last as at first; and 2ndly, for what it holds in solution, not for what it carries in an insoluble state, for that should be deposited. Now, as long as this water is kept in motion it carries its solved substances with it, and the plant (grass) that takes up the material solved takes up the water also; so that as the water loses its quality it also loses its volume, partly by evaporation and partly by absorption by the grasses, consequently the water that remains must be just of the same quality as at first.

I have not tried any analytic experiment to prove the truth of what I have here stated, nor do I think it necessary to do so, as it is of no consequence whether it be true or not to a few quarts of diminution more or less; but this we *know*, water does evaporate, and that vegetables do decompose water for their own nutrition; we know that evaporation carries off little or none of the solved matter. Upon this I found an argument, and take it as proved, that as the water diminishes in volume as well as in quality, and that if those diminutions went on in exact ratio, then the water would remain, under all circumstances, precisely of the same quality; and that for all practical purposes which we have now under consideration, it does so remain. The most satisfactory proof of the truth of this argument is found in the answer given by the meadows themselves, viz. that it is true: experience has assured that the above reasoning is correct; the water is good to the last.

It is very difficult to prove it by experiments in nature in every case. The water will act best upon the best land: therefore to expect water to exhibit as much good effect on the lower end of a meadow, where the soil is inferior in quality, as it shows on the higher end, where the soil is superior in quality, is to expect what reason ought not to ask, and that to which nature will never respond.

But these small gutters are sufficient when the little stops are taken out of the perpendicular gutters, and the level gutters are stopped so as to confine the water to the perpendiculars, to carry down as much water as ought to be carried down. The level gutter of a lower section (if it is determined that a lateral section shall be watered), instead of being fed by a large stream at the end, is supplied every ten or fifteen paces by one of those little gutters, thus giving an uniform supply throughout the length of the level gutter. A larger supply than this will afford is an evil, not a good; you do not want to *wash* the surface of your land, you want to *irrigate* it. But this fashion of sending down the water is not what I advise; I only say it can be done if required. I advise that the sections begin at the head: a surplus

will be found to run into the little gutters sufficient for the land below.

When the water is shut out from the "leading-in" gutter it is not necessary to move any of the little stops; the same perpendicular gutters that are effectual to run the water on, are as effectual to run it off, leaving the surface of the meadow dry and solid—a most manifest advantage.

The water is evenly distributed over the surface of the land by these minute gutters, which are made to follow all the undulations of the land, which can never be done by the large gutters; and also, from the draining effect of the perpendicular gutters, the water is never suffered to accumulate in ponds: the water on the meadow is, therefore, never "over-shoe" anywhere.

These gutters are no way dangerous to sheep or lambs, are never in the way of mowing, have an elegant rather than an unsightly appearance, are not perceived either in raking or carting, and suit the horse-rake or hay-making machine admirably.

I am not aware of any circumstances under which this has not the advantage over the "old plan." For wetting the ground in summer this plan has the decided superiority, as less water will do the work than will be required merely to fill the level gutters under the old system. It will be proper to remark, that grass so raised is scarcely safe for sheep; it certainly rots their livers: I found out this at the expense of many sheep. It is perfectly analogous to a plentiful rain after long drought; grass resulting thus proves equally as fatal to sheep as that produced by summer watering in a hot dry season, and *vice versâ.*

Where the stream is small, a pond should be made capable of holding as much water as will run a good stream for four hours or more; such a pond would make such a stream valuable as is really insignificant in itself. A small stream so collected will damp over 30 acres sufficiently well to secure a crop of hay.

I would just advert to the fact that the leading-in gutters can be so arranged as to tend themselves in cases of flood; but the opportunity does not present itself just now for going into that branch of the subject.

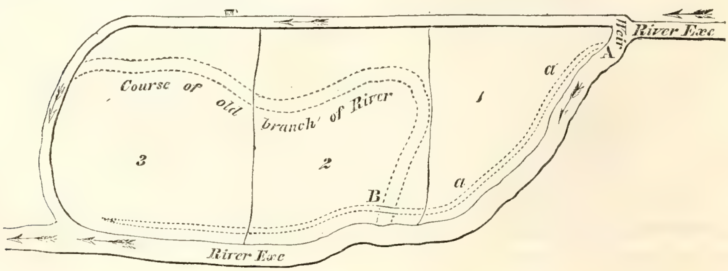
I have purposely forborne to go at all into the history of the invention, as it would be foreign to the present object in view.

VIII.—*On an Improved and Cheaper System of laying out Catch-Meadows.* By Sir Stafford Northcote, Bart.

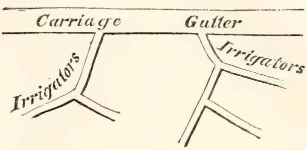
The improved system of guttering, invented by Mr. Bickford, of Crediton, and of which I have made partial use in some water-meadows in the neighbourhood of Exeter, appears to me to possess great advantages, both in efficiency and economy, over that usually practised in this neighbourhood, and seems likely to be of great value if sufficiently made known.

The meadows to which I refer are situated on the banks of the Exe, about two miles above Exeter, and lie between the river itself and the stream which is taken out of it at Pynes Weir, for supplying the city with water. The waste water of this stream returns to the Exe immediately below the meadows, so as completely to surround a space of about 30 acres. This space is divided into three meadows, of which the highest has always been in my own occupation, while the two lower pieces have been let off. Till about seven years ago they were occupied by my steward, and while he held them they were regularly watered; but they have lately been let on lease to a tenant who, for some reason with which I am unacquainted, has not availed himself of the means of irrigation which were at his command. The higher meadow, therefore, is the only one which has been watered of late years. Having now, however, taken the whole of them in hand, I proceeded, last autumn, to examine the condition of the lower meadows, in order to ascertain what was requisite to be done to supply them with water.

The nature of the ground will be most easily understood by reference to the subjoined diagram.



The water is, in the first place, brought into the higher marsh (No. 1) at A, a point a little below the weir, whence it is carried by means of a large gutter *a a* (3 feet wide and 2 feet deep) along the highest part of the land. From this gutter there are cut, at irregular distances, other and smaller gutters, which traverse the



meadow in various directions. By stopping any of these gutters with earth at any point, the water is made to overflow, and thus irrigates whatever part of the land it is desired to benefit.

The carriage gutter *a a*, after passing through the meadow No. 1, enters the meadow No. 2, where it is carried by a wooden shoot, B, over a hollow which was formerly a branch of the river. This branch is now partially filled up, and its communication with the river is entirely cut off. It serves as a drain to carry off the surface water and the waste of the irrigation.

The marsh No. 2 is extremely irregular and undulating in its character, and cannot possibly be watered by a single carriage gutter. The main gutter, *a a*, is therefore divided into several branches, which diverge very widely from one another, after crossing the shoot B. The water in former times used to be brought into one or other of these branches, by shutting it out of the others by means of wooden fenders, and it was then distributed over the marsh in the same manner as in the meadow No. 1. The carriage gutters, or some of them, were also continued into the marsh No. 3; but owing to the irregularity of the ground, and the great size of the carriers, it was impossible to water both marshes at the same time; and when it was intended to convey the stream into No. 3, it was necessary to stop the branch gutters in No. 2. I am informed by my steward that it usually took a whole day to bring the water properly over *either* of the marshes. I shall presently explain that, by the improved system, it can now be brought over *both* in about three hours.

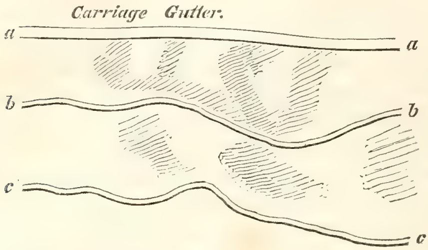
The system of irrigation invented by Mr. Bickford is as follows:—

A carriage gutter is, in the first place, cut along the line of the highest ground. This gutter is laid out in the usual manner, by means of a spirit-level, an inclination being given to it according to the nature of the ground, and the quantity of water which can be made available. Where it can be had, a fall of 2 inches in 4 land-yards, or 1 in 396, is thought desirable, but a very much less rapid fall will do. The width of the carriage gutter should be about 1 foot, and the depth about 6 inches; but these dimensions are gradually diminished as the gutter approaches its termination, so that at last it dies into the ground.

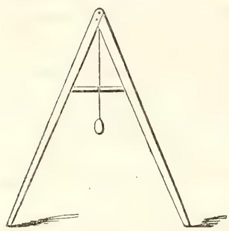
When the carriage gutter is filled, the water begins to overflow over the sides; and, were the slope of the ground exactly uniform in all directions, the water would run equally over the whole; but as the slightest inequality would prevent this, and would cause it to run in streams along the lowest parts, a series of smaller gutters are cut below, and in the same direction with, the carriage gutter, one

below the other, which catch the water, and again distribute it evenly over the land.

Thus, supposing *a a* to be a carriage gutter running along the ridge of a piece of land full of small inequalities, the water, instead of making its way along the hollows to the bottom of the field, is caught by the small gutter, *b b*, which is so cut as to be nearly level, and without any fall at all from one end to the other. The water must therefore accumulate in the gutter, *b b*, till it is quite full, when it begins to overflow at all points, and is again caught by the next level gutter, *c c*, and so on, till it reaches the drain at the bottom of the field.

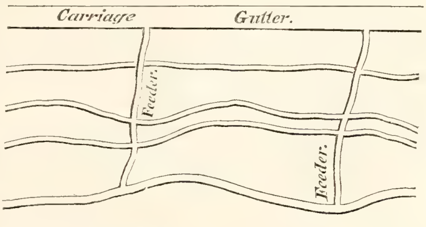


It is in the formation and use of these level catch-gutters that the peculiar merit of Mr. Bickford's system consists. They, as well as the carriage gutters, are cut with a plough, which will presently be described; but in laying them out, the use of the spirit-level is superseded by an instrument of great simplicity and convenience. It is of the form of the letter A, and stands about 5 feet high, the feet being 4 feet apart. A plumb-line is suspended from the apex, and a notch is made in the centre of the cross-piece, so that, when the two feet stand on the same level, the plumb-line crosses the notch. The gutterer rests one of the feet of the instrument on the ground, and, using this as a pivot, turns the whole round like a pair of compasses, till he finds, by the plumb-line, that the two feet stand even; then, marking the spot where the first foot stood, and using the second foot as the pivot, he finds the next level spot in the same manner, and so proceeds with great rapidity to trace out a level line throughout the field, marking each spot as he goes on; then taking the plough, he cuts a furrow along the line so marked out, which is consequently a perfectly level gutter. At points where the ground changes, so as to render it impossible to get a level, a stop is put in the gutter, and a fresh level taken for its continuation. Thus, when the higher part of the gutter is full, the water runs over the land alongside of it, and also flows over the stop, *a*, into the lower part of the gutter, which distributes it over another portion of the field. The width of these level gutters is usually about 4 inches, and the depth nearly the same, the object being to economise



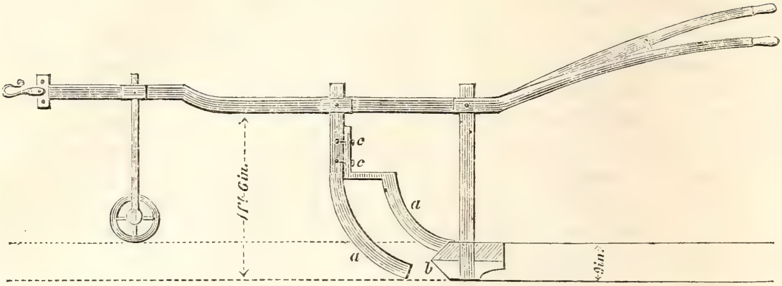
both water and space as much as possible. It is obvious that a number of deep and broad seams, following the tortuous course which must be pursued in search of a level, would take up a great deal of land, besides interposing serious obstacles to haymaking, and proving otherwise inconvenient; they have, moreover, the disadvantage of retaining a great deal of water, which filters away through the bottom of them, depositing the most valuable part of the sediment it contains in the gutter, instead of distributing it over the field; besides, they delay the process of irrigation, which it is desirable to render as rapid as possible, and, where only a small quantity of water can be obtained, they defeat the irrigation altogether; and lastly, they are more expensive to clean out when the time comes for preparing the land for watering. I am told that 2*s.* an acre is a moderate charge for cleaning out the old class of gutters; while the small level gutters may be cut afresh, when once the levels have been marked out, for just half that sum.

According to the explanation which I have now given, it will appear that the field is watered by stages; and, were the system always followed in the manner I have described, the upper stage would always receive the benefit of the greatest amount of sediment when the river is foul after the rains; the second stage would be the next in favour, and so on, till the lowest part of the field received nothing but water in almost a filtered state. This disadvantage is obviated by the use of feeders or small transverse gutters, which run from the carriage gutter at the top across all the level gutters to the lowest of all. By stops in the proper places, the water can thus be conveyed directly from the carrier to any one of the catch-gutters, without passing over the intervening land at all, and the lowest portion of the field may be watered first, and the highest last, if desired.



One more contrivance deserves to be noticed, though it is not peculiar to Mr. Bickford's system. In some cases it is desired to carry the water along a level line on the hill-side, without any fall at all. In order to make it flow, an occasional sharp turn is made, and the gutter continued at a lower level. The fall thus caused communicates motion to the water along the preceding level gutter.

The plough with which the gutters are cut was exhibited at the Exeter meeting in 1850, by Mr. Thomas Moore, of Newton St. Cyres, and was, on that occasion, "commended" by the judges. A drawing of it is annexed. The two knives, *a a*, cut a slice



of the proper width, and the furrow-slice, *b*, scoops it out at the proper depth. The width of the slice is regulated by the screws, *c c*, which attach the right-hand knife to the implement; the left-hand knife is fixed, but the right-hand knife may be taken off by unscrewing it at *c c*. When put on, it may either be screwed close up, or a space may be left, so as to leave 6 inches between the knives; when screwed up close the distance is 4 inches. In cutting a carriage gutter of a foot wide, it is necessary to go over the line twice. The price of the implement is £3.

Having thus described the chief points in Mr. Bickford's system, I must add, what will perhaps be obvious, that its success much depends upon the judgment with which it is applied. Although the level catch-gutters can be laid out with mechanical accuracy by any intelligent person capable of using the plumb-line, yet, in order to give the best direction both to them and to the carriers, a practised eye is an essential requisite. The gutterers in this part of the country are quick in perceiving irregularities in the ground which would escape an ordinary observer, and can tell, almost at a glance, in what direction the gutters can be laid out so as to economise both ground and labour. They use the plumb-line rather to correct and verify than to guide the formation of the levels. When a water-meadow has once been laid out, there is no difficulty in cutting fresh gutters with the plough along the course indicated by the original ones, and it is recommended that this should be done every season, in preference to cleaning out the old gutters. The expense is not greater; the earth which comes out of the new furrow is used for filling the old one by its side, and the growth of coarse grasses along the gutters is thus prevented. In the first laying out of a meadow, however, the services of a practised gutterer should be put in requisition. The expense—an important question—is very moderate. In the work which I have been executing in my own meadows, I have employed Mr. Edward Ellis, of Newton St. Cyres, whose charge for "irrigating, cutting, and regulating 23 acres of marsh land," amounts only to £8. 12*s.* 6*d.* or 7*s.* 6*d.* per acre. In addition to this, I paid £3. 8*s.* 6*d.* to my own labourers

employed in assisting Mr. Ellis, and I lent one of my own horses for the work. The plough was the property of Mr. Ellis.

It will be observed that, in these meadows, the carriage gutters had already been partially laid out; this, of course, saved a great deal of labour. The ground is, however, remarkably uneven, and the expense of the level gutters was consequently greater than would usually be the case. Some new carriage gutters were cut, and a good deal of labour was bestowed on reducing the size of the old gutters, which have been diminished from 3 feet wide by 2 feet deep to 1 foot 9 inches wide by 1 foot deep. (They are still larger than is desirable.) Taking all these circumstances into consideration, I am of opinion that water-meadows similarly situated might be completely laid out at an expense not exceeding £1 per acre. The annual expense of cleaning them, or of cutting fresh gutters by the side of the old ones, may be taken at 1*s.* an acre; and for these very low sums the land may be as fully, and more fully, benefited than by the old system, under which the cost could not be taken at less than £4 or £5 an acre; while the annual expense of cleaning the gutters amounted to fully 2*s.* an acre, or double the sum now required.

As an instance of the advantage of this system of watering, where only a limited supply of water can be obtained, I may mention that my steward has recently availed himself of Mr. Ellis's services in laying out two meadows of about 15 acres in extent, which are watered from a pond estimated to contain something like 50 hogsheads. In this case the water is carried along a level ridge by a carriage gutter, in which two breaks and sharp turns (as above described) occur. When it is desired to water the first part of the meadow, a stop is put at the first break, and the water overflows, and is caught by the level gutters below.

To water the second part of the meadow, the stop is put at the second break, and the water, therefore, runs out of the first part of the carriage gutter, and fills the second till it overflows.

To water the third part, the stops are removed, and the water runs, without overflowing, into the third portion of the carrier, whence it is distributed over the ground below.

STAFFORD H. NORTHCOTE.

Pynes, Exeter, June 29, 1852.

NOTE BY MR. PUSEY.

The importance of the subject will plead my excuse for once more offering to the Society a few remarks upon the principles of irrigation, especially as some misconception must still prevail respecting them, otherwise watering-gutters would not have been

compared with the pipe system in the recent able reports published by the Board of Health, as if their effects were at all similar. Whatever be the merits of the pipe system, its object is an entirely distinct one. The primary object in forming water-meadows, it cannot be too strongly insisted, is to distribute water in winter over ground which is already moist, not to convey liquid in summer into ground which is dry. Nay, this latter object is altogether protested against by many farmers, as by Mr. Bickford in his present paper, from a fear of giving rot to the sheep.

The mode in which irrigation benefits meadows is still doubtful; but I have no doubt whatever that the phenomenon is a complex and not a simple one: I mean that the causes of action are more than one, or even than two. It is important to clear up this point, as by so doing we shall then understand better how to proceed with the investigation in future. The deposition of solid matter held in *suspension* is unquestionably one principal mode of action, but assuredly not the only one, for a clear spring issuing from the hill-side sometimes begins to act at once upon vegetation as it were from the cradle. Not only are the waters of a muddy river and of a crystal brook different, but as Sir Stafford Northcote's gutterer, Mr. Ellis, informed me, the effect is distinct and sometimes opposite. A thick stream, experience shows, improves the condition of land — a clear stream may even impoverish the soil, though it brings the grass forward. There is no paradox here, if we consider that the turbid water *adds* permanently to the soil: the clear water, by stimulating the herbage, occasions elements of vegetable life to be *withdrawn* from it. If successive crops then be removed without any return of manure, the natural result will be impoverishment.

It is certain, moreover, that clear water itself has two modes of action. First, by salts it may hold in *solution*, ammonia for instance derived from the farmyard, and very probably also ammonia brought up by deep-seated springs from the depths of the earth. Here let me remark, since landowners have, I know, been deterred from attempts at irrigation by the absence of lime from their streams, that while on the one hand streams flowing from chalk-hills are undoubtedly good, softness on the other hand is the test of the best water in Devonshire, the classic land of hill-side irrigation.

The remaining cause of action is certainly warmth, and even here the action may be also a double one. Warm springs, it is well known, are the most effective, imparting, no doubt, their temperature to the ground; but all streams probably, when made to pass over land, impede the radiation of heat, that is check the escape of warmth from the ground.

Whatever the causes may be, the effect of irrigation in improving land far exceeds any other known method. Some time ago I gave a statement of the number of sheep kept by me on a water-meadow, which was thought by many to be a mistaken one. I can now say that this year the yield of my water-meadows has been further increased, and that on a piece of poor peaty land, recently irrigated, the fifth crop of Italian ryegrass has been already severed, two crops being cut and three fed off; all the crops bulky, and produced by the simple stream only, not by any liquid manure. The application of the water in dry summers is, I find, an important advantage gained in addition. I said formerly that it involved some risk of rot to the sheep, and I did not escape the rot altogether myself two years ago; but by using more precautions I find the advantage greatly preponderate.

If, as appears, land can now be irrigated at the cost of 1*l.* per acre, the profit will be at least 100 per cent., for no farmer can doubt that the yearly value of the land must be increased to the extent of 1*l.* at the lowest. I must therefore once more advise those who have streams at command, and poor land that can be flooded, to examine for themselves the West country catch-meadows, especially those recently made by Mr. Smith upon Exmoor.

IX.—*Report of Experiments on the Comparative Fattening Qualities of different Breeds of Sheep.* By J. B. Lawes, Rothamsted, Herts.

Part II.—*Cotswolds.*

In the last number of this Journal we gave, in considerable detail, the results of experiments made during the winter and spring of 1850-1, on the comparative *fattening* qualities of the Hampshire and Sussex Downs; and we stated that it was our intention to undertake, in the succeeding season, a similar experiment with the Cotswold and new Oxford breeds,—taking, after them, the Leicesters and Lincolns, and so on, until most of the breeds of importance in this country had been brought under comparison in this respect. As to the new Oxfords, however, we were unfortunately disappointed of them at the last moment; so that during the season now just past, we were only able to have the Cotswolds under experiment; and it is, therefore, the result of the trial with this breed only, that we have to record on this occasion.

We must here repeat that these experiments have not for their object the settlement of the various questions as to the adaptation of this or that breed to this or that different locality, or different treatment; but, in the course of our general investigation of the chemistry of the consumption of food by animals upon the farm, for its double produce of meat and manure, under the more and more prevailing system of artificial food and early maturity, we have sought to combine, with this more general object, a comparison of the several breeds of sheep in these respects;—that is, as to their character as early fatteners, when liberally supplied with good food.

We need not here recall special attention to the results given so fully in our last report, as to the Hampshire and Sussex breeds; but, to assist the reader in his comparison of the several breeds, we shall refer in passing to some of those results, as the various points, elicited in the experiment with the Cotswolds, come before our view. It is our wish, however, to give no bias whatever in the matter, beyond that of the facts themselves; and we should prefer that those interested in the question should study the figures and other particulars for themselves, and come to their own conclusions.

Neither is it necessary to our object to enter into any lengthened historical account of the Cotswold breed. It will be sufficient to say, on this head, that this long-woolled sheep is one of the largest in the country—that it has the character of being hardy and prolific, of having a considerable propensity to fatten, and of coming early to maturity. It is said to be of a peculiarly quiet disposition, a quality tending both to economy of food, and to its character as a fattening sheep; yet it has, nevertheless, sometimes been said to consume a comparatively large amount of food in relation to its weight. However this may be, this breed, like many others, has certainly been much improved of late years; and it was our object to obtain animals for the purposes of our experiment which should be good specimens of the modern breed. With this view, we availed ourselves of the judgment of Mr. William Garne, of Aldsworth, Northleach, Gloucestershire, whose name is well known as a prizeman for this breed, at the shows of the Royal Agricultural Society of England.

We communicated to Mr. Garne the object of our experiment, and accordingly he selected for us 50 wether lambs in October last. We were informed that they were not bred by himself, and, both by their marks and the character of the animals, we concluded that they came from at least two different flocks, some three or four, perhaps, coming from a third; at any rate, the whole seemed to be divisible into two lots about equal in number—the one averaging four or five lbs. more per head than the

other. This fact is, however, for the purposes of the experiment, perhaps rather desirable than otherwise, as giving a character not so exclusively that of a single flock as might have been the case had the animals been more strictly uniform.

In each lot, the relation of the lightest to the heaviest sheep was about as three to four; but this difference is not greater than was found with the Hampshires; and among the Sussex sheep, which were judged to be so peculiarly pure and uniform, the variation in weight was not much less.

The fifty Cotswold lambs travelled by railway to London, whence they were driven to Rothamsted, a distance of 25 miles. They arrived on October 16, 1851, and were allowed until the 24th to recover the effects of their journey, before being weighed. They were then fed upon turnips, in the field, until November 21, when they were put upon the rafters in the shed, as had been done with the Hampshire and Sussex sheep in the previous season. On November 24 the Cotswolds were re-weighed and marked; and at this date, one of each of the two apparently different lots, of equal weights, and about the average of the whole in this respect, were selected to kill as *stores*, in order to determine the proportion of carcass, &c., in the live weight in that condition.

The description of foods selected was the same as for the Hampshire and Sussex sheep, viz., oil-cake and clover chaff, as *dry* foods, given in fixed quantities, according to the average weight of the animals, and swedes, given *ad libitum*. The 48 Cotswold lambs were given these foods from November 24, when first put upon the rafters; and on December 1, when they had become accustomed both to food and situation, they were re-weighed, and the exact experiment was commenced;—the quantities of the dry foods having been fixed according to the average weight of the animals when first put upon the rafters, viz., on November 24.

It had previously been decided not to include in the exact experiment the preliminary week, in the new situation, and with the new food; though, as the result turned out, the animals during this period gave much more than the average increase in live weight; indeed, on comparing the total result of the Cotswolds under experiment with that of the Hampshire and Sussex Downs, in which is included the first week of more than usual increase, the relative gain per head of the Cotswolds will be understated by about 6 lbs., owing to this slightly different arrangement of the experiment.

In the previous experiments, the average weight per head of the Sussex sheep when they were put up (Nov. 7, 1850), was 88 lbs. and that of the Hampshires $113\frac{3}{4}$ lbs.; to the latter there

was allotted 1 lb. of oil-cake and 1 lb. of clover chaff per head per day; and to the Sussex sheep quantities in exactly the same proportion to their weight. The average weight per head of the Cotswolds when put up was 113½ lbs., identical, therefore, with that of the Hampshires; and it was decided to give them the same amount of dry food at the commencement, viz., 1 lb. per head per day, of each, oil-cake and clover chaff; and towards the conclusion of the experiment, the allowance of oil-cake was increased by one half, as it had been with the other breeds.

It will be observed that this experiment with the Cotswolds was commenced 3 weeks later in the season than that with the other breeds, there having been this delay in the hope of receiving the new Oxfords. Notwithstanding this, however, it was also closed 3 weeks earlier, the animals being already fully fit for the butcher.

In Table I., p. 183, are given—

The weight of each sheep at the commencement of the experiment, December 1, 1851;

The gain in weight of each animal during each period of 4 weeks of the experiment;

The weight of wool, shorn March 22, 1852;

The increase of each animal (including wool) during the entire period of the experiment;

The final weights, both inclusive and exclusive of wool.

In the 12th column, the average weekly gain of each animal; and at the foot of the table, the total gain of the entire lot of sheep between each period of weighing, their total wool, &c.; also the average weight per head at the commencement and conclusion of the experiment, the average weekly gain per head during each period, and the average weight of wool, shorn March 22, 1852.

This Table (I.) brings prominently to our view the point to which we have so often called attention, namely, the great variation in the rate of gain of the same animal during different consecutive periods, and of different animals of the same breed, however carefully selected, and having ostensibly the same description and quantities of food. This point we feel it is important to insist upon so often, as showing the uselessness of comparative experiments on feeding, unless both conducted with a large number of animals, and extended over a considerable period of time, so as to eliminate, as far as possible, the effects of the various sources of irregularity which we have before pointed out.

It will be seen by the Table (I.) that for the first 12 weeks, namely, up to February 23, the sheep were weighed only in regular periods of 4 weeks each. In one week from this time,

TABLE I.

Increase, &c., of each of the Cotswold Sheep.

Numbers of the Sheep.	Weights at the commencement, Dec. 1.	Increase in 4 weeks to Dec. 29.	Increase in 4 weeks to Jan. 26.	Increase in 4 weeks to Feb. 23.	Wool Shorn, Mar. 22.	Increase in 4 weeks, including Wool, to Mar. 22.	Increase in 26 days to Apr. 17.	Total Increase, including Wool, in 20 weeks.	Final Weight with Wool.	Final Weight without Wool.	Average Gain per Head per Week.
	lbs.	lbs.	lbs.	lbs.	lbs. oz.	lbs. oz.	lbs.	lbs. oz.	lbs. oz.	lbs.	lbs. oz.
1	122	18	12	12	9 10	10 10	14	66 10	188 10	179	3 5
2	103	15	15	11	8 4	9 4	7	57 4	160 4	152	2 13
3	108	18	14	17	9 9	12 9	14	75 9	183 9	174	3 12
4	121	16	10	16	9 8	4 8	17	63 8	184 8	175	3 2
5	116	16	15	14	8 13	14 13	6	65 13	181 13	173	3 4
6	134	15	19	16	10 0	8 0	8	66 0	200 0	190	3 4
7	123	16	14	3	8 0	..	..	..	..	..	..
8	114	14	17	11	13 12	12 12	12	66 12	180 12	167	3 5
9	122	9	13	16	9 0	9 0	13	60 0	182 0	173	3 0
10	121	13	9	16	10 7	16 7	16	70 7	191 7	181	3 8
11	109	17	8	16	9 12	13 12	15	69 12	178 12	169	3 7
12	146	11	16	16	8 12	16 12	17	76 12	222 12	214	3 13
13	108	14	14	9	7 3	15 3	16	68 3	176 3	169	3 6
14	108	19	18	15	8 0	16 0	9	77 0	185 0	177	3 13
15	121	16	11	13	10 0	7 0	13	60 0	181 0	171	3 0
16	108	16	16	10	9 0	12 0	15	69 0	177 0	168	3 7
17	140	15	16	18	11 12	11 12	12	72 12	212 12	201	3 0
18	109	15	16	14	9 0	9 0	14	68 0	177 0	168	3 6
19	129	11	11	13	8 8	7 8	5	37 8	166 8	158	1 14
21	121	11	14	8	9 12	7 12	8	48 12	169 12	160	2 7
22	109	11	10	10	8 12	3 12	12	46 12	155 12	147	2 5
23	123	17	17	16	9 3	6 3	14	70 3	193 3	184	3 8
24	127	15	14	16	11 1	15 1	20	80 1	207 1	196	4 0
25	109	14	10	11	9 5	8 5	10	53 5	162 5	153	2 10
26	116	14	5	12	8 10	16 10	10	57 10	173 10	165	2 14
27	119	17	11	13	9 2	17 2	17	75 2	194 2	185	3 12
28	132	16	14	13	10 10	9 10	14	66 10	198 10	188	3 5
29	117	14	16	14	10 7	12 7	17	73 7	190 7	180	3 10
30	135	13	12	8	9 12	5 12	15	53 12	188 12	179	2 11
31	119	16	16	14	10 1	10 1	10	66 1	185 1	175	3 4
32	122	16	11	10	8 0	8 0	11	56 0	178 0	170	2 12
33	128	15	8	17	10 1	7 1	18	65 1	193 1	183	3 4
34	133	17	11	12	11 9	0 9	3	43 9	176 9	165	2 2
35	112	16	9	12	8 6	7 6	12	56 6	168 6	160	2 13
36	112	16	15	17	8 8	16 8	8	72 8	184 8	176	3 10
37	121	14	6	12	9 8	11 8	16	59 8	180 8	171	2 15
38	120	17	21	12	10 0	killed	..	..	..	..	..
39	132	11	9	9	9 0	10 0	16	55 0	187 0	178	2 12
40	120	0	8	9	8 8	13 8	10	40 8	160 8	152	2 0
41	108	14	1	22	8 13	10 13	13	60 13	168 13	160	3 0¾
42	125	15	15	7	9 8	15 8	14	66 8	191 8	182	3 5
43	112	14	8	13	9 5	9 5	16	60 5	172 5	163	3 0
44	105	17	14	17	8 2	5 2	10	63 2	168 2	160	3 2
45	122	13	13	14	10 0	16 0	15	71 0	193 0	183	3 8
46	123	10	20	17	8 11	6 11	12	65 11	188 11	180	3 4
48	130	22	16	12	11 2	11 2	11	72 2	202 2	191	3 9
49	128	12	9	12	9 2	6 2	10	49 2	177 2	168	2 7
50	112	17	22	17	10 0	10 0	23	89 0	201 0	191	4 7
Totals	5754	698	619	632	445 12	484 12	578	2928 12	8439 12	8004	145 5¾
	Mn. per Head. lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	Mn. per Head. lbs. oz.	lbs. oz.	lbs. oz.	Mn. per Head. lbs. oz.	Mn. per Head. lbs. oz.	Mn. per Head. lbs.	lbs. oz.
Means; and Average Weekly Gain per Head during each period.	119 14	3 $10\frac{4}{14}$	3 $3\frac{7}{12}$	3 $\frac{1}{6}$	9 4½	2 10	3 5	63 10	183 7	174	3 2½

namely, on March 1, the allowance of oil-cake was increased from 1 lb. to $1\frac{1}{2}$ lb. per head per day. A fortnight later, namely, on March 15, or 3 weeks after the last weighing, the animals were weighed, and then washed preparatory to being shorn. In one more week, that is on March 22, which was the date for the regular monthly weighing, the animals were shorn; and the wool and sheep each separately weighed. From the last date to April 17 constituted the next and final period, of 26 days only, instead of 28, as previously, it being necessary thus to close the experiment 2 days short of the regular monthly period, in order to secure the Monday's Smithfield Market for those animals which were to be sold alive.

At the foot of column 12 of the table, it is seen that the average weekly gain of weight per head of the entire lot of sheep, during the 20 weeks of the experiment, is 3 lbs. $2\frac{1}{2}$ ozs.

We need not, perhaps, make further comment upon this table of details excepting to note in explanation of it, that one of the sheep, namely, No. 7, became unwell after being washed, and died by scouring shortly afterwards; and another, No. 38, was "killed to save its life," not long after being shorn. In the tables which follow, therefore, the particulars only of the 46 remaining sheep will be given. As to the *construction* of these tables we need not enter into any explanation in this place, having called particular attention to this point in our former paper; and, indeed, we have endeavoured so to arrange them, as that they should afford a sufficient explanation for themselves. As to their *results*, too, we shall go less into detail than in the former paper, especially as we shall have, to some extent, to reconsider the whole when the experiments with other breeds are completed.

In the six following tables are given:—

In Table II. the *total food* consumed, and total increase in live weight produced between each weighing, &c.

In Table III. the quantities of *food consumed* during each single period and the total period of the experiment, *to produce* 100 *lbs. increase* in live weight.

In Table IV. *the food consumed per head* weekly.

In Table V. *the food consumed per* 100 *lbs. live weight* weekly.

In Table VI. the *average increase in weight per head* weekly.

In Table VII. the *average increase upon each* 100 *lbs.* live weight weekly.

TABLE II.

Showing the Description and Quantities of Food consumed, and Increase produced, by 46 Cotswold Sheep, between each interval of Weighing.

Periods.	Length of Time.	Oilcake.	Clover Hay.	Swedes.	Increase in Live Weight.
	Weeks.	lbs.	lbs.	lbs.	lbs. ozs.
From Dec. 1 to Dec. 29 .	4	1288	1288	18,461	665 0
„ „ 29 to Jan. 26 .	4	1288	1288	17,602	584 0
„ Jan. 26 to Feb. 23 .	4	1288	1288	22,701	617 0
„ Feb. 23 to Mar. 22 .	4	1771	1288	21,493	484 12
„ Mar. 22 to Apr. 17 .	4	1794	1196	23,935	578 0
Total increase of 46 Cotswold sheep in 20 weeks	20	7429	6348	104,192	2928 12
Average food consumed and increase produced by 46 sheep in 4 weeks	..	1485.8	1269.6	20,838.4	585 10

TABLE III.

Showing the Quantities of Food consumed during each period to produce 100 lbs. Increase in Live Weight by Cotswold Sheep.

Periods.	Length of Time.	Oilcake.		Clover Hay.		Swedes.
	Weeks.	lbs.	ozs.	lbs.	ozs.	lbs.
From Dec. 1 to Dec. 29 . . .	4	193	10	193	10	2776
„ „ 29 to Jan. 26 . . .	4	220	8	220	8	3014
„ Jan. 26 to Feb. 23 . . .	4	208	12	208	12	3679
„ Feb. 23 to Mar. 22 . . .	4	365	5	265	11	4433
„ Mar. 22 to Apr. 17 . . .	4	310	6	206	14	4141
Average for the entire period of the experiment . .	20	259	11	219	1	3608

TABLE IV.

Showing the average Weekly Consumption of Food per Head for each period of the experiment.

Periods.	Length of Time.	Oilcake.		Clover Hay.		Swedes.	
	Weeks.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.
From Dec. 1 to Dec. 29 . .	4	7	0	7	0	100	5
„ „ 29 to Jan. 26 . .	4	7	0	7	0	95	10
„ Jan. 26 to Feb. 23 . .	4	7	0	7	0	123	6
„ Feb. 23 to Mar. 22 . .	4	9	10	7	0	116	13
„ Mar. 22 to Apr. 17 . .	4	9	12	6	8	130	1
Average for the entire period of the experiment . .	20	8	1	6	14	113	4

Table V.

Showing the average Weekly Consumption of Food, per 100 lbs. Live Weight of Animal, for each period of the Experiment.

Periods.	Length of Time.	Oilcake.		Clover Hay.		Swedes.	
	Weeks.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.
From Dec. 1 to Dec. 29 . . .	4	5	8	5	8	78	15¾
,, ,, 29 to Jan. 26 . . .	4	4	15½	4	15½	68	0½
,, Jan. 26 to Feb. 23 . . .	4	4	8¾	4	8¾	80	5
,, Feb. 23 to Mar. 22 . . .	4	5	13	4	3½	70	8¼
,, Mar. 22 to Apr. 17 . . .	4	5	8	3	10¾	73	6
Average for the entire period of the experiment . .	20	5	4¼	4	9¼	74	4

Table VI.

Showing the average Weekly Increase per Head during each period of the experiment.

Periods.	Length of Time.	Cotswold Sheep.	
	Weeks.	lbs.	ozs.
From Dec. 1 to Dec. 29 . .	4	3	9¾
,, ,, 29 to Jan. 26 . .	4	3	2¾
,, Jan. 26 to Feb. 23 . .	4	3	5½
,, Feb. 23 to Mar. 22 . .	4	2	10
,, Mar. 22 to Apr. 17 . .	4	3	2
Average for the entire period of the experiment . .	20	3	2¼

Table VII.

Showing the average Weekly Increase per 100 lbs. Live Weight for each period of the Experiment.

Periods.	Length of Time.	Cotswold Sheep.	
	Weeks.	lbs.	ozs.
From Dec. 1 to Dec. 29 . .	4	2	13½
,, ,, 29 to Jan. 26 . .	4	2	4
,, Jan. 26 to Feb. 23 . .	4	2	2¾
,, Feb. 23 to Mar. 22 . .	4	1	9½
,, Mar. 22 to Apr. 17 . .	4	1	12¼
Average for the entire period of the experiment . .	20	2	2

An inspection of Tables II. and IV. will show that, as in the case of the Hampshire and Sussex sheep, the Cotswolds consumed more food as they increased in size and weight; but

Table V., which gives the consumption *per* 100 *lbs. live weight*, shows that there is no decided either progressive increase or diminution of consumption *to a given weight of animal*, which can be clearly referred to the state of progress of the animal. On the other hand, the fluctuations in this respect would seem to be more probably connected with the state of the weather and of the animals in relation to it. Consistently with this idea, and also with the result of the experiments with the Hampshire and Sussex sheep, we have the consumption in relation to a given live-weight most increased at the time when the animals lost the protection of their wool.

Table III. shows that as the experiment proceeded a larger amount of food was required to yield a given amount of increase in live weight. This was also the case with the Hampshire and Sussex sheep. Our experiments on the composition of animals in various stages of fatness lead us to believe, however, that this seeming diminished effect of the food as the animal progresses to maturity is perhaps more apparent than real; for as the animal ripens, the increase is found to be much less aqueous than during the earlier periods of growth. Hence it may be that there is as great, if not even greater, deposition of real solid substance from a given amount of food as maturity is approached, though the proportion of the gross live weight may be less.

It is not improbable, however, that some portion both of the actual increased consumption and of the lessened relation of increase to it, as the experiment proceeded, might be due to some depreciation in the nutritive quality of the turnips as the season advanced.

From Table VI. we learn that the average increase in live weight, *per head*, of the 46 Cotswolds, during the 20 weeks of the experiment, was 3 lbs. $2\frac{1}{4}$ ozs. That of the Hampshires during the entire period of the experiment was, however, only 2 lbs. 12 ozs., and that of the Sussex sheep only 2 lbs. $1\frac{3}{4}$ ozs.

Again, in Table VII. we see that the average weekly increase per 100 lbs. live weight was with these Cotswolds 2 lbs. 2 oz.; that of the Hampshire was 1 lb. 14 ozs.; and that of the Sussex sheep, 1 lb. $10\frac{3}{4}$ ozs.

The following is a short tabulated summary, bringing to view the comparative results of the three breeds, in regard to some of the points given for the Cotswolds, more in detail in the preceding Table.

TABLE VIII.

Summary of results of Cotswold, Hampshire, and Sussex Sheep.

	Average Food consumed to produce 100 lbs. Increase in Live Weight.			Average Food consumed per Head Weekly.			Average Food consumed per 100 lbs. Live Weight Weekly.			Average Gain in weight per Head Weekly.	Average Gain in Weight per 100 lbs. Live Weight Weekly.
	Oilcake.	Clover Chaff.	Swedes.	Oilcake.	Clover Hay.	Swedes.	Oilcake.	Clover Hay.	Swedes.		
	lbs.	lbs.	lbs.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Cotswold .	259¾	219	3608	8 1	6 14	113 4	5 4¼	4 9¼	74 4	3 2½	2 2
Hampshire.	294	259	3941	8 0	7 0	106 10	5 6	4 12¾	71 7	2 12	1 14
Sussex . .	314	304	4086	6 3	5 14	79 1	5 6	5 2	68 14	2 1¾	1 10¾

From Division 1 of this summary we learn that the Cotswolds consumed the least food to produce a given amount of increase in live weight, and the Sussex sheep the most.

From Division 2 we see that the Cotswolds consumed the largest amount of food per head, weekly; and the Sussex sheep the least.

In Division 3 are given the quantities of food, *in the fresh state*, consumed *per* 100 *lbs. live weight weekly*, by the several breeds; and there is some general uniformity observable in the amount consumed to a given weight of animal by the different breeds. But when the quantities of the respective foods are calculated each to their contents of *dry substance*, it is found that the total quantity consumed to a given weight of animal, within a given time, *is all but absolutely identical for the three breeds.*

Lastly, in Divisions 4 and 5 respectively we see that the average weekly gain in live weight, whether calculated *per head* or per 100 lbs. live weight, is greatest with the Cotswolds, and least with the Sussex sheep.

We would here call attention to the fact, that the increase in weight, *per* 100 *lbs. weekly*, though greatest with the Cotswolds, is even with them very little more than 2 lbs., that is, 2 per cent.

The next point is as to the quantity of wool shorn from the Cotswold sheep. By reference to Table I. it will be seen that the date of shearing was March 22nd, and we have there given the amount of wool taken from each animal separately, and the total amount from the 48 Cotswolds. In Table IX., which follows, we have given the *average* quantity of wool obtained per

head, and per 100 lbs. live weight, of the whole lot of Cotswolds; and for the convenience of comparison we have added the same particulars relating to the Hampshire and Sussex sheep.

Table IX.

	Average Wool per Head.		Proportion of Wool to 100 lbs. Live Weight of Animal at the Time of being Shorn.
	lbs.	ozs.	
Wool shorn from Cotswolds, March 22, 1852 . .	9	$4\frac{3}{4}$	5·44
Wool shorn from Hampshires, March 27, 1851 . .	6	4	3·77
Wool shorn from Sussex, March 27, 1851 . . .	5	10	4·57

From this Table it appears that the long-woolled Cotswold sheep gave more than half as much again *wool per head* as either the Hampshire or Sussex sheep. The Cotswold, again, gave $5\frac{1}{2}$ per cent. of wool upon its live weight; the Hampshire giving only $3\frac{3}{4}$ per cent., and the Sussex sheep $4\frac{1}{2}$ per cent.

We now come to the question of the character of the Cotswold sheep, as *meat*-producers. It will be remembered, that in the case of the Hampshire and Sussex sheep, out of the 40 of each breed, the 4 which had increased most, the 4 that had increased least, and the 8 of medium increase, were killed at home; the weights of the carcasses and of all the viscera being taken separately, and the carcasses sold at Newgate Market; and the 8 of next larger, and the 8 of next smaller increase, were sold alive at Smithfield. With the Cotswolds a similar plan was adopted. Thus, of the 46 sheep, the 5 of most, the 5 of least, and the 10 of medium increase, were killed at home; the weight of all the parts separately taken, and the carcasses sent to Newgate Market. The 10 of next larger, and the 10 of next smaller increase, were sold alive at Smithfield, and the remaining 6 were kept to be fed till Christmas. The only exception to this arrangement was, that 2 of the animals thus allotted by their increase in weight to be kept till Christmas, were exchanged for 2 of the others of about equal weight, but which were less ripe and more adapted for feeding on, than the 2 in question.

The following summary of average qualities within each set as thus allotted, will show how far the method of selection adopted was calculated to yield a fair average of qualities in the respective lots:—

TABLE X.

	Average Increase per Head, including Wool.		Average Wool per Head (Shorn Mar. 22).		Average Original Weight, Dec. 1, 1851.		Average Final Weight, April 17, 1852, without Wool.	
	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.
Mean of the 20 killed at home	63	0	9	$2\frac{3}{4}$	119	12	173	10
Mean of the 20 sold alive	65	$1\frac{1}{2}$	9	12	119	5	174	11
Mean of the 6 to be kept till Christmas . .	61	$0\frac{1}{2}$	9	$8\frac{1}{2}$	121	5	172	13
Mean of the 46 Sheep .	63	10	9	$4\frac{3}{4}$	119	13	174	0

In the next Table (No. XI.) are given at one view, some of the main particulars whilst alive, of the animals to be killed at home, by the side of those ascertained on killing them.

In this Table we find with these Cotswolds, that there was some degree of uniformity as to rate of increase in weight within each of the three lots, drawn out for killing; though comparing lot with lot, we see that the 5 of largest increase gave an average actual increase nearly double that of the 5 of smallest increase. On the other hand, as shown in the summary, the average increase per head of the 10 of medium increase, of the whole 20 killed, and of the whole 46 sheep fed under experiment, was very nearly equal. This was also the case with the Hampshire and Sussex sheep; and as with them, we find also with the Cotswolds, that those animals thus brought together within each lot as having increased in weight at nearly equal rates, had few other qualities in common.

Thus, turning to the column of the amount of wool given by the Cotswolds, we see, that although the *average* of any one lot does not differ much from that of either of the others, or of the whole 46 sheep, yet the amount obtained from the different individual sheep is almost equally variable among those of the largest, those of the smallest, and those of the medium rate of increase, respectively.

In the column of *carcass-weight*, we see that the 5 sheep which increased most, gave on April 19th, when therefore they were little more than a year old, an average of 113 lbs. 15 oz., or 14 stones and nearly 2 lbs. (8 lbs. per stone). The 5 of smallest increase gave at the same time an average of $90\frac{3}{4}$ lbs. carcass, equal to 11 stone $2\frac{3}{4}$ lbs.; and the 10 of medium increase gave an average of 99 lbs. 6 oz. carcass, or nearly $12\frac{1}{2}$ stones. The average carcass weight of the whole 20 killed was 101 lbs., or 12 stone 5 lbs.; this is exactly the weight to which the Hampshires had been brought in the previous season by May 8, after

26 weeks of experiment; and the average weight of the Sussex carcasses at the same date was 9 stone 5 lbs.

The next two columns of Table XI. show the proportion of carcass to live weight. In the first, it is calculated upon the *un*-fasted live-weight, and in the second upon the fasted. It is worthy of remark, that whichever basis of calculation is taken, the Cotswolds are found to have given a larger percentage of carcass

TABLE XI.

Numbers of the Sheep.	WEIGHTS ALIVE.					WEIGHTS DEAD.			
	Increase per Head, including Wool, in 20 Weeks.	Wool per Head, shorn March 22.	Original Weights on Dec. 1, 1851.	Final Live Weights, without Wool. Not Fasted.	Final Live Weights, without Wool. Fasted.	Carcass 28 to 36 hours after Killing.	Proportion of Cold Carcass in 100 Unfasted Weight.	Proportion of Cold Carcass in 100 Fasted Weight.	Proportion of Loose or Inside Fat in 100 Fasted Weight.
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.			
50	89 0	10 0	112 0	191 0	178 0	112 7	58·8	63·18	4·99
24	80 1	11 1	127 0	196 0	185 0	114 10	58·5	61·96	3·98
14	77 0	8 0	108 0	177 0	170 0	107 6	60·6	63·16	4·14
12	76 12	8 12	146 0	214 0	200 0	128 2	59·9	64·08	4·94
27	75 2	9 2	119 0	185 0	173 0	107 2	57·9	61·94	4·82
Mean of 5 largest.	79 9	9 6	122 6	192 9	181 3	113 15	59·14	62·86	4·57
49	49 2	9 2	128 0	168 0	157 0	98 12	58·8	62·92	6·09
22	46 12	8 12	109 0	147 0	140 0	76 0	51·7	54·28	4·89
34	43 9	11 9	133 0	165 0	157 0	96 0	58·2	61·16	4·36
40	40 8	8 8	120 0	152 0	143 0	89 14	59·1	62·88	4·08
19	37 8	8 8	129 0	158 0	154 0	93 6	59·1	60·63	6·00
Mean of 5 smallest.	43 7	9 4	123 12	158 0	150 3	90 13	57·38	60·37	5·84
13	68 3	7 3	108 0	169 0	157 0	96 7	57·1	61·44	5·82
42	66 8	9 8	125 0	182 0	171 0	104 13	57·6	61·29	6·27
31	66 1	10 1	119 0	175 0	166 0	101 6	57·9	61·07	5·23
5	65 13	8 13	116 0	173 0	165 0	102 15	59·5	62·40	6·50
46	65 11	8 11	123 0	180 0	172 0	106 14	59·4	62·13	5·60
33	65 1	10 1	128 0	183 0	170 0	102 13	56·2	60·49	6·21
4	63 8	9 8	121 0	175 0	164 0	100 4	57·3	61·14	5·04
44	63 2	8 2	105 0	160 0	153 0	96 10	60·4	63·17	5·45
41	60 13	8 13	108 0	160 0	154 0	89 10	56·0	58·22	4·51
43	60 5	9 5	112 0	163 0	152 0	92 6	56·7	60·77	4·69
Mean of 10 medium.	64 8	9 0	116 8	172 0	162 6	99 6	57·81	61·21	5·53
SUMMARY.									
Mean of 5 largest.	79 9	9 6	122 6	192 9	181 3	113 15	59·14	62·86	4·57
Mean of 5 smallest.	43 7	9 4	123 12	158 0	150 3	90 13	57·38	60·37	5·84
Mean of 10 medium.	64 8	9 0	116 8	172 0	162 6	99 6	57·81	61·21	5·53
Mean of 20 killed.	63 0	9 2¾	119 12	173 10	164 0	100 15	58·11	61·48	5·31
Mean Total	63 10	9 4¾	119 13	174 0	..	..	..	..	..

carcass weight than either the Hampshire or Sussex sheep of the previous experiment; both of these, however, as has already been stated, were put earlier in the season upon the fatting food than the Cotswolds, and were kept upon it later.

These long-woolled sheep were, indeed, very fully ready for the butcher. They very remarkably, too, manifested the *characteristics* of the white-faced, long-woolled sheep, as contrasted with the black-faced Down. Thus, although, as we have stated, their proportion of carcass was greater, and the carcasses themselves were much fatter than in the case of either of the other breeds, yet the kidneys of these Cotswolds were by no means well made up. The rumps, and saddle generally, and breast, were, however, too fat; indeed, the fat was chiefly accumulated *outside* the frame instead of inside, as is more the case with the Downs: there was, too, a deficiency of lean in the Cotswold carcasses. Some of the rumps and breasts were extraordinarily fat, especially of the 5 animals which had given the greatest increase. The 10 of medium increase were the best made up on the kidneys, and had also the best distribution of lean. The 5 of least increase were the whitest and most delicate; they were in every way less fat; they had altogether less of the character of the fat long-woolled sheep, and would well have borne to be fed a little longer. On the other hand, the carcasses of the 5 sheep of largest increase were much coarser in appearance, and the surface was much more streaky and vascular.

It may be remarked, that there is no clearly evident connexion between rapidity of fattening and the *proportion* of carcass. There is nearly equal variation in regard to proportion of carcass weight, among the animals of greatest, of least, and of medium increase respectively.

As to the *actual* proportion of dead or carcass weight to live weight, in these early ripened sheep, we may observe that 57·14 per cent. of carcass is equal to a stone of 8 lbs. dead for a stone of 14 lbs. alive, and that the average proportion of carcass of each lot of these sheep is higher than this. Thus, taking the calculations upon the gross, or unfasted, live weight, the 5 animals of largest increase gave an average proportion of carcass of 59·14 per cent., the 5 of smallest increase of 57·4 per cent., and the 10 of medium increase 57·8 per cent. The average of the whole 20 killed is 58·1 per cent. The 5 animals of largest increase, which gave such a large *actual weight* of carcass, and upon the whole, the heaviest *proportion* of carcass, were nevertheless deficient in kidney and inside fat generally.

Looking to the column of loose, or caul and gut fat, we see that the average proportion of it in 100 of the fasted live weight of the 20 Cotswolds was 5·3. In the Hampshire and Sussex sheep it was more than 7 per cent. The Table shows also that

the animals of largest increase, and which were the fattest, especially on the outside of the frame, gave on the average the least proportion of inside or loose fat. The 10 sheep of medium increase gave upon the whole the largest proportion of loose fat; though, owing to a large amount in 2 of the animals of smallest increase, the *mean* of these is higher than that of the former.

In fact, the more the original character of the large, rapidly growing Cotswold sheep prevailed, the greater was the proportion of fat on the outside of the carcass, and the coarser was the mutton. On the other hand, the quality was the best the less there was of tendency to excessive fat on the carcass, and the greater the proportion on the kidneys, and of inside fat generally.

It has been well said, that the Cotswold is not so much the butcher's, or gentleman's, as the poor man's sheep—supplying as it does, when sold as meat, a small proportion of bone and a large proportion of fat—but yielding to the butcher comparatively little profit in the shape of tallow-cake and loose fat. Whether or not the Cotswold is the *farmer's* sheep is, however, a question to which no unconditional answer can be given. This must depend upon many local circumstances, such as the character of the land, and of the farming adopted, and also the character of the demand. As to the question of demand, it is probable that wherever *quality of mutton* has much influence on its price, and this rather than quantity is most sought after, the Cotswold and other white-faced sheep will, other things being equal, not be so profitable as their character as rapid and early fatteners, upon a given amount of food, would, at first sight, lead us to suppose. But we shall recur to the question of price further on.

As in the case of the Hampshire and Sussex sheep (and of most animals which have been killed at home after having been fed under experiment, and, indeed, of others also) we have, as already stated, taken the weights of all the separate internal parts, or "offal," of the 20 Cotswold sheep. We reserve, however, any further points connected with this subject until we have opportunity of considering all the facts which we have collected relating to it. Indeed it would be out of place to go into them at any length just now.

We have found, then, by an examination of the particulars of the *dead weights* of the Cotswold sheep, that they gave a heavier carcass in a given time than either the Hampshire or Sussex sheep—a somewhat heavier proportion of carcass to live weight—a considerably less proportion of loose or inside fat, but a considerably larger amount of fat on the outside of the frame.

We now come to the question of the money result of this experiment upon the fattening qualities of the Cotswold sheep.

As already stated, the experiment was concluded on April 17th, and the whole of the sheep were weighed on that day.

Twenty were sent off alive in carts the next evening for the Monday morning's Smithfield market of April 19th. On the same day, the 20 allotted for killing at home were slaughtered; their carcasses were sold at Newgate Market on the 21st, and their offal was sold at home. The particulars of these sales are given in the following Table. No estimate is this time made for the (six) sheep to be fed till Christmas, the statement being confined to the 40 sheep actually sold.

TABLE XII.
Produce of Sale of the Cotswolds.

	Weight in lbs.		Produce of Sale.		
	lbs.	ozs.	£.	s.	d.
20 carcasses, at 2*s.* 10*d.* per stone of 8 lbs.	1968	0	34	17	0
Wool, at 12½*d.* per lb.	183	7	9	11	1
Skins, at 8*d.* each	..		0	13	4
Heads and plucks, at 1*s.* 3*d.*	..		1	5	0
Loose fat, at 1*s.* 11*d.* per stone of 8 lbs.	172	0	2	1	2½
			48	7	7½
Killing, at 8*d.*, 13*s.* 4*d.*; Selling and Charges at Newgate Market, 20*s.* 6*d.*	..		1	13	10
Net for the 20 sheep sold dead	..		46	13	9½
Net *per head* for the 20 sheep sold dead	..		2	6	8¼
20 sheep, sold alive, at 36*s.* per head	..		36	0	0
Wool, at 12½*d.* per lb.	195	2	10	3	3
			46	3	3
Selling and charges	..		0	13	4
Net for 20 sheep sold alive	..		45	9	11
Net average per head for 20 sheep sold alive	..		2	5	5¾

SUMMARY.

	£.	s.	d.
20 Sheep, sold dead	46	13	9½
20 Sheep, sold alive	45	9	11
Total	92	3	8½
Average per head for the 40 sheep	£ 2	6	1

It is seen by this Table of the produce of sale that the carcasses of the Cotswolds, sold dead, fetched 2*s.* 10*d.* per stone at Newgate Market. The net return per head of the sheep sold alive was about 1*s.* 3*d.* less than for those sold dead. And if we reckon the average weight of the carcasses at a little above 12 stones,

this would reduce the price per stone of the carcasses of the sheep sold alive by a little more than 1*d.* below that of those sold dead, that is, to about 2*s.* 9*d.*

So fluctuating are the markets that it would of course be impossible to institute any exact comparison as to the produce of sale of the Cotswolds with that of the Hampshire and Sussex sheep without first comparing the state of the market at the different times of sale. We shall defer, however, any full consideration of the subject in this point of view until we have completed our experiments with other breeds. In the mean time, however, we subjoin a balance-sheet of the experiments with the Cotswolds in the same form as given for the Hampshire and Sussex Downs; but for the reasons stated above we shall not, on this occasion, go into a full consideration of its bearings; nor need we here repeat our explanation of the plan and object of a balance-sheet in the particular form adopted; in which, as will be seen, we have only the cost of the lambs and of their dry or marketable food on the one side, set against the net produce of sale of the fat sheep and their wool on the other.

Table XIII.

Balance Sheet of the Cotswolds.

	£.	s.	d.	£.	s.	d.
Cost of 40 Cotswold wether lambs, at 33*s.* 3*d.* . . .	.	.		66	10	0
They consumed, of purchased food,—						
6460 lbs. of oilcake, at 6*l.* 15*s.* per ton . . .	19	9	3¾			
5520 lbs. of clover hay, at 4*l.* per ton . . .	9	17	1¾			
Total of purchased food . .	.	.		29	6	5½
				95	16	5½
40 fat Cotswolds, sold April, 1852 (with wool) . .	.	.		92	3	7½
Difference	.	.		3	12	10

After the remarks above, introducing this balance-sheet, we need only here say, in explanation, that, as before in estimating the cost of the lambs at the commencement of the experiment, 3*d.* per head per week is charged for their board up to that time; and we may add, that (so far to aid the comparison) the oilcake and clover-chaff are charged exactly at the same rates as for the Hampshire and Sussex sheep, regardless of any fluctuations in the cost of those articles.

It may also be noticed that the market in which these Cotswolds were sold was quoted as "exceedingly heavy"; and it will be observed that the increase of the fat sheep with their wool did not cover the cost of the dry foods by about 3*l.* 13*s.*, instead of within 6*s.* or 7*s.*, as was the case with the Hampshire and Sussex sheep. These, however, were also sold in a bad market.

We have only now to add a general tabulated summary, giving at one view the results embodied in detail in the preceding Tables

of this paper; and for the convenience of comparison we have, where it seemed useful, placed by their side the particulars of the Hampshire and Sussex sheep on the same points.

Table XIV.

General Summary.

PARTICULARS—(Cotswold Sheep.)	Actual Results of Experiments. Cotswold.	Hants.	Sussex.	Percentage relation of Hants to Cotswold.	Percentage relation of Sussex to Cotswold.
	lbs. oz.	lbs. oz.	lbs. oz.		
Average weight per head when put up, Dec. 1st	119 13	113 7	88 0	94·67	73·44
Average weight per head when fat (including wool)	183 7	183 1	141 0	99·79	76·86
Total increase in weight of 46 sheep (Cotswolds) in 20 weeks	2,928 12	..	..	..	..
Increase per head weekly	3 2¼	2 12	2 1¾	87·13	66·83
Increase upon 100 lbs. live weight weekly	2 2	1 14	1 10¾	89·02	79·37
Total food consumed by 46 Cotswolds in 20 weeks — Oilcake	7,429 0	..	..	..	..
— Clover Hay	6,348 0	..	..	..	..
— Swedes	104192 0	..	..	..	..
Food consumed per head weekly — Oilcake	8 1	8 0	6 3	99·22	76·74
— Clover Hay	6 14	7 0	5 14	101·81	85·45
— Swedes	113 4	106 10	79 1	94·15	69·81
Food consumed per 100 lbs. live weight of animal weekly — Oilcake	5 4¼	5 6	5 6	102·07	102·07
— Clover Hay	4 9¼	4 12¾	5 2	104·77	111·94
— Swedes	74 4	71 7	68 14	96·17	92·72
Food consumed to produce 100 lbs. increase of live weight — Oilcake	259 12	294 0	314 4	113·18	120·98
— Clover Hay	219 1	259 12	304 3	118·57	138·85
— Swedes	3,608 0	3,941 0	4,086 0	109·25	113·24
Total wool of 46 sheep, shorn March 22d	427 12	..	..	..	..
Wool per head ditto ditto	9 4¾	6 4	5 10	67·22	60·50
Wool per 100 lbs. live weight of animal, when shorn	5·44	3·775	4·567	69·39	83·95
	st. lbs. oz.	st. lbs.	st. lbs.		
Average weights of cold carcass in stones of 8 lbs. — Of the 5 largest and 5 smallest increase. — Weights taken at home	12 6 5	12 6¼	9 4	100·18	74·28
— Weights allowed by butcher	..	12 4	9 2	..	..
Of 10 medium increase. — Weights taken at home	12 3 6	12 4¾	9 5¾	101·38	78·24
— Weights allowed by butcher	..	12 2	9 4¼	..	..
Of the 20 killed — Weights taken at home	12 4 15	12 5¼	9 5¼	100·56	76·78
— Weights allowed by butcher	12 2 0	12 3	9 3		
Proportion of carcass (cold) in 100 lbs. of the *gross* live weight of animal, April 17th (*i. e., not fasted*) — Of the 5 largest	59·14	56·87	57·16	96·16	96·65
— Of the 5 smallest	57·38	56·42	56·15	98·33	97·85
— Of the 10 medium	57·81	56·82	57·41	98·28	99·31
— Of the 20 killed.	58·11	56·73	57·03	97·63	98·14
Proportion of carcass (cold) in 100 lbs. of the fasted weight — Of the 5 largest	62·86	61·24	61·81	97·42	98·32
— Of the 5 smallest	60·37	60·00	59·28	99·39	98·19
— Of the 10 medium	61·21	60·64	60·57	99·08	98·97
— Of the 20 killed	61·48	60·63	60·56	98·63	98·49
	lbs. oz.	lbs. oz.	lbs. oz.		
Average weight of loose fat per head (weighed warm) — Of the 5 largest	8 11½	12 15½	10 4¼	148·63	117·65
— Of the 5 smallest	8 2	11 5	8 6¾	139·23	103·65
— Of the 10 medium	9 8	12 7	10 2½	130·92	106·90
— Of the 20 killed	8 15	12 3¾	9 9¾	136·89	107·51

PARTICULARS (Cotswold Sheep).		Actual Results of Experiments.			Percentage Relation of Hants to Cotswold.	Percentage Relation of Sussex to Cotswold.
		Cotswold.	Hants.	Sussex.		
Proportion of loose fat in 100 lbs. fasted weight	Of the 5 largest	4·57	6·54	7·08	143·10	154·92
	Of the 5 smallest	5·84	7·34	7·17	125·68	122·77
	Of the 10 medium	5·53	7·24	7·45	130·92	134·72
	Of the 20 killed	5·31	7·02	7·10	132·20	133·71
		s. d.	*s. d.*	*s. d.*		
Price of the carcass per stone of 8 lbs.	1st sale	2 10	2 9	3 0	97·06	105·88
	2nd do.	..	3 3	3 4½	114·70	119·12
Gross money return per head of the 20 Cotswolds sold dead (without wool)		37 1½	..	..	..	..
Gross money return per head of the 20 Cotswolds sold alive (without wool)		36 0	..	..	..	..
Average value of wool per head		9 8	7 0½	6 6½	72·84	67·67
Price of wool per lb.		1 0½	1 1½	1 2	108·00	112·00

X.—*On the Mode of extracting Manure from Sewage Water, practised at Cardiff Gaol.* By Thornton J. Herapath, Assistant-Lecturer on Practical Chemistry in the Bristol School of Medicine, &c.

To Mr. Pusey.

Sir,—Much attention, as you are aware, has of late been directed by agriculturists and sanatorists to the application of sewage and sewerage-water to the fertilization of land; and consequently any process by which such matters can be at the same time readily and economically defecated, and converted into a good and useful manure, will be doubtless considered of sufficient interest to merit a notice in the Journal. Enclosed in this letter is a sample of prepared night-soil which was recently placed in my hands for analysis; and as I thought that the process by which it was manufactured might be new to the majority of the members of the Royal Agricultural Society, I have taken the liberty of offering you a few remarks upon it, in the hope that I might thus afford some useful hints which might serve to guide others in their endeavours to convert what has hitherto proved a cause of disease and annoyance to the community at large into a source of national wealth and importance.

The specimen of manure forwarded to you was prepared by the prisoners at the Cardiff Gaol, where the mode of manufacture referred to has been for several years in operation.

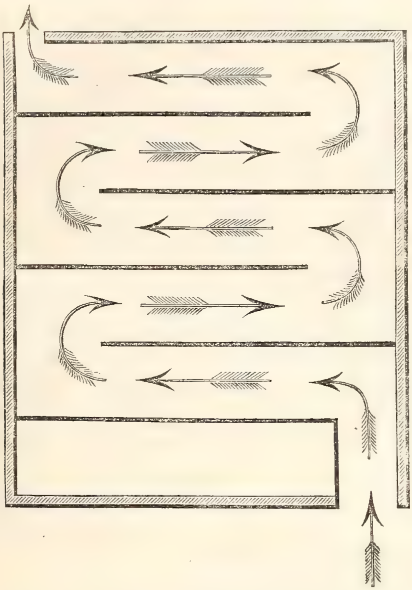
Upon subjecting some of it to a chemical examination, I found its composition to be as follows:—

Water	4·71
Organic matters, containing 1·125 grains of nitrogen (= 1·366 grs. of ammonia)	15·91
Salts of potash and soda, soluble in water . .	a little
Carbonate of lime with some carbonate of magnesia .	69·28
Sulphate of lime	3·26
Earthy phosphates, containing 2·03 grs. of phosphoric acid	4·10
Silica and other insoluble matters	2·74
	100·

Now, good farm-yard manure contains, as an average, according to my own experiments, about ·42 per cent. of nitrogen, and ·65 per cent. of phosphoric acid. Hence, this defecated night-soil may be said to possess between three and three and a half times the value of farm-yard dung.

On obtaining such favourable results, I applied to Mr. Woods, the Governor of the Cardiff Gaol, for some account of the method by which the manure is prepared, and was referred by that gentleman to Mr. Higgs, of London, who kindly furnished me with the subjoined information. Near the outfall or at any convenient point of the sewer's course, a series of tanks are erected into which the sewerage-water is conducted, being either run into them from a higher level or raised by pumping. These tanks are filled in succession, and as the sewage flows in, it is mixed with the chemical agent (in most cases, milk-of-lime), which is added in just sufficient quantity to effect the precipitation of the fæcal matters, &c. The first tank having been filled, it is allowed to remain at rest, whilst the same operation is being carried on in the others. In the course of a few hours the manure is completely deposited, at the bottom of the tank, in the form of a pulp or paste. The supernatant water is then drawn off, and the vessel is ready for the next charge.

Whilst the operation is being performed, the cover of the tank, which is air-tight, is kept shut down, and the air that is expelled on the entrance of the sewage, together with any offensive and pernicious gases that might be liberated by the action of the caustic lime on the fæcal matters, &c., escapes by a pipe and is conducted into a chamber or purifier, where it is compelled to pass over several layers of peat charcoal saturated with dilute hydrochloric acid. This chamber is somewhat similar in construction to those employed in the purification of coal-gas in many manufactories, and presents a section like the annexed diagram.



Whilst passing through this apparatus, the air is deprived of all traces of ammoniacal vapour, and is afterwards conducted into a chimney, which conveys it away.

The contents of the purifying chamber, when fully saturated with ammoniacal salts, are removed and sold as manure or otherwise applied to some useful purpose; fresh charcoal is then placed in their stead. When several precipitations have been effected, and it becomes necessary to remove the deposit that has accumulated in the tank, a valve at the lower part of the vessel (and to which the bottom inclines) is lifted up, and the semi-fluid mass contained in the cistern is allowed to flow off into a trough placed beneath, whence it is transferred to a series of endless linen bands, revolving in a hot-air chamber. By these means the manure is soon rendered perfectly dry, and is then fit for the market. When the quantity of manure manufactured is limited, and labour is of little or no object, it has been found preferable to mould the deposit by hand, and stove-dry it. The latter method, I believe, is at present pursued at the Cardiff Gaol.

The water that runs off from the deposit in the tanks is almost wholly inodorous, perfectly clear and limpid; and, if first passed through a filter of animal charcoal, might even be made use of for drinking, although a natural prejudice would of course prevent it from being so employed.

It might, however, be well rendered available for the irrigation of land in those places where the level would admit of its being economically distributed. Indeed, the small quantity of alkaline

and calcareous salts which it holds in solution would render it admirably adapted for this purpose; far more so than common spring or river water, as it contains a much larger proportion of fertilizing ingredients. The manure prepared by the above-described process, as I need hardly point out to you, would be apt to vary considerably in composition at different times, and under different circumstances, particularly if the manufacturer were not careful in apportioning the lime to the sewage matters; but when properly made, of course it ought never to be less rich than the specimen analysed.

We want experience before we can decide as to the exact value of this fertilizer. But few *experimental* trials have been made with it, and consequently its powers have not as yet been fully proved. I have been informed, however, that wherever it has been used, it has furnished very satisfactory results, particularly when applied to wheat crops, and used in conjunction with some alkaline manure.

I remain, Sir,
Yours respectfully,
THORNTON J. HERAPATH.

Mansion House, Old Park, Bristol,
April 10th, 1852.

Numerous plans have been lately suggested for the application of town-sewage to agriculture, but without, I believe, any decided success. Many towns, too, I understand, are just completing new sewage arrangements, and are at a loss how to apply the contents delivered at the new outfall. It is, therefore, doubly important that a gentleman of Mr. Herapath's authority on chemical subjects has made us acquainted with a plan tested by some years' experience. The manure so prepared, which he was so good as to send me, is absolutely inodorous.—PH. PUSEY.

XI.—*On the Use of Nitrate of Soda as a Top-dressing for Wheat, at Holkham.* By H. W. KEARY.

To Philip Pusey, Esq.

DEAR SIR,—I am sorry I have not been able sooner to send you the enclosed results of my experiments with nitrate of soda and salt, as a top-dressing for wheat. I think you asked for a short explanation as to the mode and time of application. I believe the safest rule for commencing is, to do so when the wheat first makes a start in early spring, and as this does not of course always occur at the same time every year, but depends entirely upon the season, no fixed rule as to time can be laid down. I have generally begun to top-dress about the middle of March,

putting on about half the quantity I intend to apply *then*, and the remainder should be added not later than the middle of April, in average seasons. I have not yet met with a machine that will sow this mixture accurately, and it is, therefore, always applied by hand, and it requires a careful man to do it nicely. To ensure greater regularity, the first application should be made the same way the wheat is drilled, and the second directly across it, and thus any slight imperfections of sowing are of less consequence.

I am decidedly of opinion, that nitrate of soda is a most useful and profitable top-dressing for wheat upon all light *gravelly* and *sandy* soils, if properly and judiciously applied. The addition of double the weight of common salt I hold to be most important; it *corrects* the exuberant growth of straw which nitrate of soda alone produces, stiffens it, and prevents the crop being laid—and, what is even more important, materially improves the quality and weight of grain.

Results of Experiments on the Top-dressing of Wheats with Nitrate of Soda and Salt, made upon Holkham Park Farm, 1850 *and* 1851.

No. of Exp.	TOP-DRESSING.	Cost of the Top-Dressing.	Yield of Corn per Acre.	Increase in Corn over Exp. No. 2.	Weight of Straw grown per Acre.	Increase in Straw over Exp. No. 2.
	1850.					
		£. s. d.	Bus. pks.	Bus. pks.	Tns. cwt. st.	Tns. cwt. st.
1	6 st. nitrate of soda, 16 st. salt	0 14 6	45 2	4 2	1 12 2	0 6 2
2	Without top-dressing.	..	37 0	..	1 6 0	..
3	8 st. nitrate of soda, 16 st. salt	0 18 6	40 0	3 0	1 14 0	0 8 0
4	4 st. ditto, 8 st. do.	0 9 3	39 0	2 0	1 10 4	0 4 4
5	10 st. ditto, 20 st. do.	1 3 3	40 0	3 0	1 12 4	0 6 4
6	8 st. ditto, without salt	0 16 0	40 0	3 0	1 12 0	0 6 0
	1851.					
1	6 st. nitrate of soda, 16 st. salt	0 14 6	42 2	4 3	1 13 1	0 5 6
2	Without any top-dressing . .	..	37 2	..	1 7 2	..
3	8 st. nitrate of soda, 16 st. salt	0 18 6	45 1	7 2	1 16 5	0 9 2
4	4 st. ditto, 8 st. do.	0 9 3	43 1	5 2	1 13 4	0 6 2
5	10 st. ditto, 20 st. do.	1 3 3	47 0	9 1	1 18 4	0 11 2
6	8 st. ditto, without salt	0 16 0	43 3	6 0	1 17 1	0 9 7

MEM.—Seven loads of farm-yard manure per acre applied over the whole field before ploughing the clover-ley.

My object in instituting these experiments has been to ascertain, if possible, the most *profitable* quantity of nitrate of soda and salt as a top-dressing for wheat in spring. You will observe that, although nearly all the results are satisfactory in each year, they are nevertheless somewhat contradictory as to the degree of

quantity. In 1850, 6 st. of nitrate and 16 st. of salt produced the greatest increase of corn, and of course paid a greater percentage upon the outlay than the larger applications; but in the following year, 10 st. of nitrate and 20 st. of salt produced double the increase of the 6 st. dressing; and I am, therefore, inclined to think that the season has much influence on the effects of nitrate of soda when applied to grain crops, and the quantity which would answer best this year may probably produce different results in the following, with a different state of atmosphere during the summer months. I shall, however, try the same experiments again and again until something like a decided conclusion can be arrived at. I am this year applying, upon the Holkham Park Farm, 7 st. of nitrate of soda and 16 st. of salt upon nearly 400 acres of wheat, with the fullest confidence that it will pay a large percentage upon the outlay, even with the present prices of wheat. If you wish for any more information upon this subject I shall be glad to give it you.

I remain, dear Sir, yours faithfully,

H. W. Keary.

Holkham, March 27, 1852.

XII.—*On a New Method of Hoeing Turnips.* By Philip Pusey.

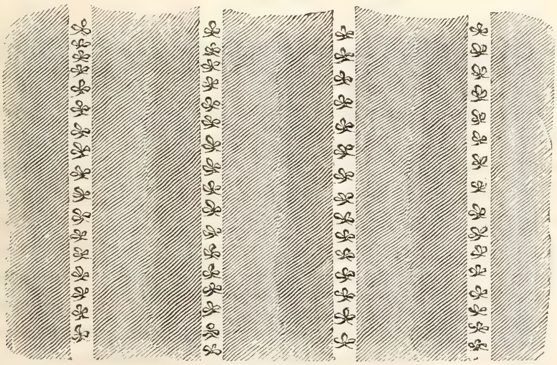
Before detailing an improved method of hoeing turnips discovered by me during the leisure from public duties which has been afforded me in the present month of July, it will be useful, as some readers of this Journal may not be practical farmers, to state the defects of the existing methods.

According to the old-fashioned practice, still the most common in this and I suppose some other counties, the turnips are sown broad-cast. Afterwards, in order to thin out superfluous plants, to get rid of weeds, and to keep the soil open, they require three hoeings by hand, which cost together at least ten shillings per acre, or half the average rent of English land. Nor is the expense the least evil, for it is of course a slow process to move the whole surface even of a single acre with the common hand-hoe. But on a moderate farm a hundred acres often require this operation at once; the weather may be propitious and the want pressing. All the hands on the farm are insufficient, and no others can be procured. The right time, therefore, for some of the work passes by. Nay further, it happens constantly that a yet more urgent necessity arises at the same time, the necessity for securing the harvest. The turnips are left to themselves, the weeds almost smother the crop, the surface of the ground becomes baked, and the roots have soon suffered irremediably.

Good farmers, however, have now generally given up sowing their turnips broad-cast, and in southern England usually drill them four rows at once, covering a width of six feet. When this is done, Garrett's horse-hoe, passing between the four rows, cleans the intermediate space with the utmost rapidity. Still, admirable as is the process, it has been as yet incomplete. For the young plants shooting up vigorously in the rows under the influence of artificial manure, soon grow together, requiring immediate attendance. If then they cannot be thinned out quickly enough by hand, although, in desperation as it were, the harrow is sometimes dragged across them, they become interlaced, are drawn up prematurely, and the spindling plants, when at last singled out, resemble trees of a plantation that has been neglected in the same manner. Their robustness is gone.

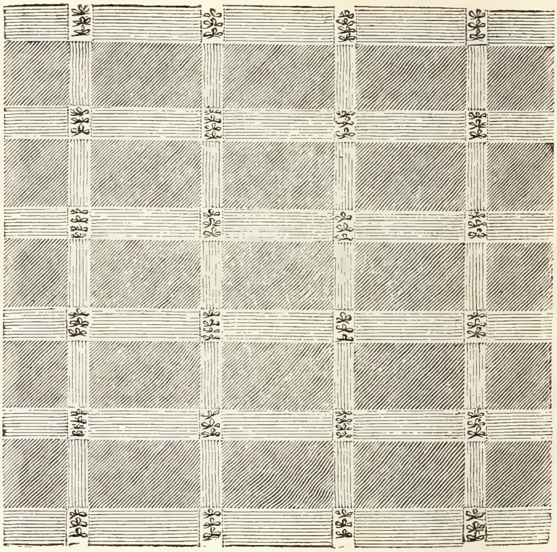
Having fifty acres of turnips exposed to this risk, and no workmen to save them, it occurred to me that Garrett's horse-hoe might be used across as well as along the rows. The indiscriminate slaughter of thriving plants was at first rather alarming; but when the fallen had withered beneath a scorching sun, it was evident that a good and regular crop remained safe. The whole, therefore, was subjected to the process, and I shall use no other in future. It may be useful then, I hope, to describe the method precisely, because the success of all operations lies mainly in minute particulars, though in this case there are none which any practical farmer might not find out for himself.

In the common use of the horse-hoe the knives pass down four rows at once, and they may safely be set with their backs only 3 inches apart, though they thus approach within 1½ inch of the young plants on each side. As the rows are 19 inches asunder, a width of 16 inches is cleared, and about one-sixth of the surface remains untouched.



Straight-hoed Turnips.

In the new process, however, of afterwards crossing the rows, the hoe must be set differently, as it would be wrong to leave so few turnips as an interval of 19 inches along the rows would spare. It might also be hazardous to set the backs of the knives at 3 inches only apart, because even in a regular crop blanks might occur at that interval. As yet, therefore, we have left a space of 5 inches. In crossing, consequently, ten hoes instead of eight must be used, and five spaces instead of four must be hoed, so that the turnips will stand 15 inches apart along the length of each row.



Turnips Straight-hoed and Cross-hoed.

The next step is to reduce to single plants the small bunches of turnips left by the cross-hoeing; and this is best done by young children—the younger the better—as the smaller they are the nearer they are to their task, and pliancy of fingers, not strength, is the quality wanted. It is easy to borrow, for the purpose, the younger classes of a school for a few days: it is, in fact, a holiday for them in fine weather, and their parents are glad that they should earn 4*d*. a day. About thirty of these little workpeople, each singling a separate row of turnips, under one steady manager, do the work well and rapidly. It is not uncommon to employ children thus, the turnips having been previously *bunched out*, as it is termed, with the handhoe. The plants which are thus finally left stand in lines, from whatever point they are viewed.

Afterwards it may be necessary, before the plants have spread their leaves and covered the ground, that women should go rapidly over the field with a hoe, merely to strike out occasional weeds, in which last operation each person, I find, can finish off nearly 2½ acres in a day.

The expense of the whole is as follows. As to the horse-work, I am certain that a farmer ought not to charge himself more than half-a-crown a day for horses kept regularly at work on the farm. One lad steers the implement and drives the horse with reins at the same time, when the work lies in the direction of the rows, as a quiet horse sees his path plain before him; but in crossing the rows a boy also must be employed to keep the horse straight. The horse-hoe should go over at least 8 acres each day.

For 8 acres :—	*s.*	*d.*
One straight hoeing	3	6
One cross hoeing	4	0
Second straight hoeing	3	6
Children singling, at 1*s.* 4*d.* per acre .	10	8
Hand-hoeing, at 6*d.*	4	0
	25	8
One acre completed	3	2½

The saving, therefore, effected by this complete use of Garrett's horse-hoe, as compared with the hand-hoe,* is nearly 7*s.* per acre, about the same saving as we derive from the American reaper.

The cost of the implement is extremely moderate, as Mr. Garrett is ready, at my suggestion, to sell his four-row horse-hoe fitted for the turnip-crop only at the low price of 14*l.*

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* The cost of hoeing, even where the horse-hoe is partially used, is stated in the Report on Northamptonshire, printed in the present Journal, at 10*s.* to 12*s.* per acre. The same writer says, that a greater weight can be grown on the flat than on the ridge. In the North, however, the ridge is perhaps preferable. In the South the hurried nature of our turnip-sowing affords the strong argument for the quick process of drilling four rows at once.—*Ph. P.*

I have pointed out elsewhere an important gain, besides cheapness, which arises from improved implements, namely, certainty. Every practical farmer will see at once the advantage, if, by a mechanical process, without checking his harvest, he can carry forward his turnip-crop from the time when it peeps above ground until its spreading leaves hide the land from our sight.

There is even a further benefit at which I may venture to hint. It is well known that many parishes of southern England contain at present more labourers than can be easily employed during the winter half of the year. But they are required for about three months in summer, and the farmers are therefore unwilling to favour their removal by emigration. This maximum demand in summer, however, arises from three operations—haymaking, turnip-hoeing, and harvest; if then these three several demands for extra labour are reduced by the use of machinery, the pressure for hands in summer being no longer felt, there will no longer be any reason for detaining families whose presence in winter tends to burthen the ratepayer, while their own condition is depressed by the slack demand for their labour.

Pusey, July 31st. PH. PUSEY.

Having inquired of Mr. Garrett whether his horse-hoe had been used by others in the same manner, I am glad to learn from him that two other agriculturists at least, perhaps more, have so used it recently, and to subjoin their statements in support of my own. The first is from Mr. Cottingham, of Leiston Hall, who says:—

"I have been much pleased with your horse-hoe's performance in hoeing turnips out. Each set of hoes were fixed to cut clean 12 inches, leaving 6 inches space between each. After the horse-hoe had been taken directly plumb across the stetches, they were singled by children, and they now look remarkably well. Of course there was a full plant. My turnips growing so very rapidly this season, if it had not been for your horse-hoe, I should have had many acres much injured for want of getting them out in proper time."

The second account is from Mr. Williams, manager of Mr. Sidney Herbert's farm at Wilton:—

"I commenced the cross horse-hoeing last year on some late sown turnips, which convinced me that it was practicable, should the plants be regular and without blanks in the rows. The turnips require to be horse-hoed as soon as they are in rough leaf. I have this year thus horse-hoed all my mangolds and swedes, and I have found it to be the cheapest, and by far the most perfect method that I have tried or seen. I intend to cut all my late turnips in the same manner."

I understand from Mr. Herbert that his colleague, Mr. Wyndham, has also used the same method successfully.

August 17th.

XIII.—*On the Farming of Cumberland.* By WILLIAM DICKINSON.

PRIZE REPORT.

PART I.

THE writer of this report on the farming of Cumberland has thought he could best fulfil the intentions of the Royal Agricultural Society, as laid down for the guidance of competitors for their premium, by treating separately each subject to which they direct attention, but their rules specify no distinct period by which the account of "ancient farming" should be limited; that subject is brought into notice in various places throughout the work, and the practice of former times is thus given as a parallel or contrast to the subjects of modern farming immediately treated of. As the report is intended to be suggestive as well as descriptive, the "improvements still required" (though summarily noticed, as desired, under a separate head) will each be found connected with their proper subject in the body of the essay.

Though the writer's long connexion with the agriculture and rural population of this his native county has afforded him an intimate and extensive acquaintance with its economy in every branch, yet he considers himself fortunate in having obtained the assistance of a host of agricultural friends, of whose experience and information on many interesting topics he has been happy to avail himself, and to whom he gratefully begs to express his obligations.

He may be pardoned for stating that he is better skilled in the methods of conducting than of describing the practices of husbandry, but that his descriptions are faithful.

I. DESCRIPTION OF STRATA AND SOILS OF THE COUNTY.

Notwithstanding all that has been written by scientific men on the geology of this county, none have satisfactorily shown that the soils, generally speaking, convey anything like a correct indication of the underlying rocks. Where the rocks are near the surface, of course the connexion is more intimate: but so much of the low-lying parts, and some at a considerable elevation, are so deeply covered with the diluvium conveyed from distant parts that, in very many places, the surface conveys no adequate idea of what rocks may be expected beneath. Where this diluvium prevails, it covers all rocks alike, from a depth of a few inches to some hundreds of feet. Nearly the whole of the new red sandstone, the coal-fields, the carboniferous limestone of the lower country, and the skirts of the older rocks are covered with it. In most parts of the county, and especially in the west, it is largely intermixed or overlaid with a compact clay, which is very

retentive of water. Over a great extent this clay (in which more or less of the rounded drift-gravel is embedded) forms the subsoil, and the intermediate and sometimes alternating strata from the soil to the rock. As the clay or the sand predominates, it forms the wheat or the barley soils, if the elevation suit those crops; but at the higher levels, where the cultivation of wheat ceases or is precarious, these variations of subsoil, in connexion with the depth and kind of soil, form the gradations of the different qualities of the upper and inferior grass-lands. The new red sandstone, with the grits belonging to it, occupies a greater space than any other rock, and fills up the great valley of the Eden and Solway. Gypsum is found at several places in this formation along the Eden, from near Carlisle to Westmoreland; it is also found at Barrow Mouth, a little to the south-west of Whitehaven. Numerous experiments have been made of its uses in agriculture, but none have resulted in any great benefit, except as a fixer of ammonia* in stables, &c.

A small bed of magnesian limestone is met with near Shawk, and another near the gypsum-bed at Whitehaven. Both have been very sparingly used in agriculture, but neither approved.

A singular dyke of dark whinstone has been protruded through the sandstone, from near Wreay to the edge of Hartside Fell, a distance of about 12 miles. Where this dyke appears on the surface of the higher sandstone ridges the soil is of better quality, though the width is only a few yards. Very generally the clays of the red sandstone contain thin beds of sand, which assist the drainage materially.

The coal-field extends along the coast from St. Bees to Maryport, and from thence to Hesket-new-Market. There are also patches of coal in Nichol Forest and Bewcastle, more at Farlam and Talkin, and some small beds of the kind called crow coal (only useful for burning lime) on Hartside and Crossfell. The soils of the coal-field vary exceedingly in character, from fine fertile alluvium to the most sterile of the wet clays; and the changes are very frequent, often two or three kinds of soil in the same field, each requiring some different treatment.

The limestone edges the coal-field from Egremont, round the base of the mountains, to Penrith. The eastern boundary from Crossfell and Priorsdale to the Kershope and Liddel, is well supplied with mountain limestone. The southern portion of this contains valuable metalliferous veins, and in the northern portions the limestone mostly appears at the edges of the "burns" or streams, the beds alternating with shale. The summits of most of the elevations of this range are crowned with a coarse millstone grit, of an infertile character.

* Common agricultural salt is found equal or superior to gypsum for this purpose, and is cheaper.

Many years ago Professor Liebig predicted that England would some day derive an addition to her agricultural wealth from the remains of an extinct animal world. He has lived to see the phosphoric deposits of the Suffolk crag extensively applied to agriculture in what are called coprolites. The carboniferous limestone of Egremont contains a layer of sandy ferruginous shale, about 12 to 18 inches thick, which is abundantly interspersed with coprolitic kidney-shaped nodules, and with what appear to be fragments of fossilized bones. The nodules are by far the more numerous portion, and are chiefly of a flattened oval or cylindrical shape, from 1 to 8 or 9 inches in length, some of them contorted and others having indentations like the eyes of the potato. The upper soil * is very strongly impregnated with iron, and the crevices and beds of the limestone, as well as the pseudo-coprolites (or whatever other term may be applied to these nodules), are tinged with the deep red of the hematite iron-ore. No great quantity can be obtained at a time as yet, as the stratum dips to the west along with the heavy superincumbent mass of limestone. But if found of any agricultural or chemical value (of which there can be no doubt) future researches may bring to light other and more extensive deposits in other limestone districts, as well as this.

The limestone soils are generally drier than other soils, from the cavernous nature of the limestone strata, and their produce, especially in herbage, is of good quality.

Along the edges of the strata on Hartside-fell, Bolton, and other limestone districts, there are numerous funnel-shaped holes,† which admit water into the open strata, but do not, in all cases, drain the land. In some places the limestone is overspread, below the soil, by a few inches of fine blue or white marl,‡ quite impervious to water, on account of which the chinks of the rock are prevented from acting, and the soil is mostly wet.

Small patches of limestone are found at different places, as at Dobcross, in the sandstone; Distington and Hensingham, in the coal-measures; Hail, on the junction of the slate and sandstone; Whicham and Millom, on the verge of the greenstone. These detached portions are of some convenience to persons at a distance from the main beds.

It is somewhat singular that the old red sandstone appears nowhere in the county, either in its legitimate place or out of it, except one small portion at the south-western foot of Crossfell,

* This soil produces as good crops of all kinds as the brown soils of known good quality, though it is red as blood.

† Provincially, "swally (swallowing) holes."

‡ This is mostly of good quality for application to other than limestone soils. It pulverizes, on exposure, like burned lime.

and a smaller one still at Naworth, and these are in their regular places.

The remainder of the county is composed of the older series of rocks, the metamorphic, the slaty, and the granitic. In the spongy peat soils which cover the tops, the more level parts of the sides, and most of the upper valleys of the mountains of all these various formations, a great quantity of water is suspended, and there the herbage is mostly coarse.

Around the bases of the mountains, of whatever formation, are found soils of a most fertile description, calculated as to quality (but not often as to climate) for producing every usual kind of crop, and especially grass.

II. Peculiarities of Climate as they affect Crops.

The effects of climate on the agriculture of a country, and its influence on the operations of husbandry, are so important, that it was the wish of the writer to have entered more fully into meteorology; but the materials at command were found, upon investigation, so inadequate to the objects he had contemplated as to preclude the possibility of doing so with satisfaction.

Not only are few journals of the weather regularly kept by private persons for any considerable number of years consecutively, but those which have been so kept are difficult to combine on account of their distance from each other and their difference of position, being the results of observations made at different altitudes, as well as subject to other variations from sundry causes which more directly affect a mountainous country, especially one bordering on the ocean. A very accurate journal of the weather was formerly kept for several years at Carlisle by the late Mr. Pitt, and afterwards one not less so by the late Rev. Mr. Matthews at Wigton.

But the distances of these places from each other would altogether prevent the connecting of these observations correlatively together, so as to deduce from them any accurate results; the average temperature of Carlisle being apparently in excess of the temperature of Wigton by 2°, and the quantity of rain varying also considerably at the two places, though the elevations above the sea are nearly the same.

The late Mr. Atkinson, of Harraby, kept also, for some years, a very accurate journal, which, being in the immediate neighbourhood of Carlisle, might be considered to be nearer in accordance with Mr. Pitt's. But it appears that, even in this short distance, a variation in the average fall of rain has been noticed to the extent of $1\frac{1}{2}$ and 2 inches annually, and probably a still greater difference in the temperature.

The observations made by Mr. Pitt extended over 24 years,

viz. from the 1st of January, 1800, to the end of December, 1824. His locality at Carlisle 40 feet above the sea-level. They were published after his death by Dr. Barnes, of Carlisle, in the Transactions of the Royal Society of Edinburgh, and are considered valuable. Having been kept by a very careful observer, and by means of the best instruments then to be procured, so far as they extend they may be relied on, and may prove of infinite advantage to some future observer, as indicative of meteorological changes.

To enable useful conclusions to be drawn from meteorological observations, it is necessary to have them continued without interruption, at the same spot and under the same circumstances, for a long period of years. This can only be effected through the instrumentality of philosophic institutions dedicating a portion of their attention and time, as well as their ample funds and efficient instruments, to this branch of science.* Still meteorological observations have been made by several accurate observers of late years in various parts of the county. Mr. Miller, of Whitehaven, some time ago established a system of observations relating to the lake-district, and it is through his kindness that several of the columns of the following tables are supplied.

TABLE of Rain Journals kept at the following places.

A.D.	Keswick,—258 feet above the Sea. Mr. Miller.	Wigton,—Norman Inglis, for the Rev. R. Matthews.	Crewgarth,—Mr. J. P. Spedding.	Penrith,—Mr. Bird.	Carlisle,—40 feet above the Sea.	Greystoke.	Whitehaven.			Flosh.—Mr. Miller.	Cockermouth,—127 feet. Mr. Miller.	Bassenthwaite Haws,—210 feet. Mr. Miller.	Gillerthwaite in Ennerdale,—396 feet. Mr. Miller.	Loweswater Lake,—336 feet. Mr. Miller.
							High Street,—90 feet. Mr. Miller.	Round Close,—480 feet. Mr. Miller.	St. James's Church,—78 feet. Mr. Miller.					
1844	40·62	31·90	22·23	..	..	..	36·72	..	27·86	39·31	..	..	54·62	49·82
1845	62·20	36·42	28·48	..	..	..	49·20	..	33·48	53·00	46·93	..	76·88	69·54
1846*	67·67	41·60	31·78	..	..	56·76	49·13	..	35·42	55·16	52·41	..	83·87	79·24
1847	58·28	33·33	25·35	..	..	37·79	42·92	42·02	30·71	47·80	42·55	44·45	80·13	66·29
1848	66·40	35·01	28·45	..	..	44·02	47·34	46·70	36·34	60·82	52·37	47·06	97·73	76·66
1849	48·80	29·34	25·29	..	..	36·39	38·99	..	28·21	45·13	38·39	40·00	76·41	55·28
1850	59·52	30·77	26·53	..	..	43·04	40·47	..	28·63	51·28	47·74	46·97	84·63	68·79
1851	62·33	30·50	25·66	36·245	27·17	38·58	43·12	..	32·11	51·66	..	45·41	84·38	67·10

* Very heavy thunderstorms in this year.

* The present scientific labours of Mr. J. F. Miller, F.R.S., Mr. Isaac Fletcher, and others in West Cumberland, and of Joseph Coulthard, Esq., and others in East Cumberland, will, it is hoped, be continued long enough to establish correct data in the meteorology of Cumberland.

Table of Rain Journals—*continued.*

A.D.	Crummock Lake,—260 feet. Mr. Miller.	Gatesgarth,—290 feet. Mr. Miller.	Eskdale. Centre of Vale,—Mr. Miller.	Eskdale. Head of Vale,—Mr. Miller.	Wasdale Head,—247 feet. Mr. Miller.	Borrowdale. Seathwaite, 368 feet. In Garden, 6 inches above surface. Mr. Miller.	Borrowdale. Seathwaite, 368 feet. In Field, 18 inches above surface. Mr. Miller.	Borrowdale. Stonethwaite,—330 feet. Mr. Miller.	Tarn Bank,—207 feet. Mr. J. Fletcher.	Broughton Moor,—410 feet. Mr. J. Fletcher.	Brampton Crofthouse,—Joseph Coulthard, Esq.	Harraby.	Scotby,—101 feet above Sea. Mr. J. Clarke.	Alston,—Joseph Dickinson, Esq.
1844	61·46	80·01	..	..	..	..	..	..	..	..	..	..	..	..
1845	87·48	124·13	..	..	108·55	151·87	..	..	..	..	..	..	..	..
1846*	96·47	121·90	..	..	106·93	143·51	..	..	..	..	..	..	..	..
1847	82·32	106·25	58·66	74·93	96·34	129·24	126·80	106·21	..	..	..	..	..	..
1848	98·07	133·55	70·38	86·78	115·32	160·89	157·22	130·24	..	..	..	..	..	..
1849	70·21	97·09	..	71·22	107·22	125·47	..	94·27	38·71	31·82	..	..	..	..
1850	85·66	108·84	..	81·69	108·76	143·96	..	105·81	41·02	34·35	..	..	..	..
1851	84·08	107·00	..	78·58	97·94	139·60	..	114·12	40·97	32·18	$28\frac{5}{8}$	24·11	26·91	40·38

* Very heavy thunderstorms in this year.

The following Table gives the Monthly quantity of Rain in the Year 1851 at the places mentioned.

Months.	Whitehaven,—¼ mile from Sea.	Broughton Moor,—2½ miles from Sea.	Tarn Bank,—4¼ miles from Sea.	Carlisle,—7 miles from Solway.	Harraby,—8 miles from Solway.	Scotby,—9½ miles from Solway.	Crofthouse, Brampton, 14 miles from Solway.	Brampton,—50 feet below Crofthouse.	Greystoke,—23¼ miles from Allonby.	Penrith,—23 miles from Solway, 28 miles from Allonby.	Crewgarth,—33½ miles from Allonby.	Alston,—28 miles from Solway, 41 miles from Allonby.	Wigton,—6½ miles from Solway.
January . .	9·41	4·94	10·96	4·16	3·56	6·96	4·$\frac{5}{8}$	4·79	7·53	9·50	4·16	9·17	..
February . .	3·77	4·21	3·38	1·72	1·60	1·62	2·$\frac{4}{8}$	1·96	·82	2·12	1·12	2·93	..
March . . .	3·45	3·17	2·71	2·84	2·75	2·63	2·$\frac{2}{8}$	2·20	4·93	3·70	2·77	3·56	..
April . . .	2·30	1·31	2·30	1·09	1·31	·70	1·	1·14	2·06	2·15	1·58	2·14	..
May	1·06	1·06	·94	·65	·71	·79	[illegible]·$\frac{2}{8}$	·60	1·00	1·05	·80	1·58	..
June . . .	3·88	2·62	2·46	3·37	2·96	1·82	2·	3·53	3·39	2·51	2·14	3·22	..
July	3·47	2·82	3·55	2·76	2·17	3·00	4·$\frac{2}{8}$	3·90	5·41	3·48	3·00	6·26	..
August . .	4·06	3·41	3·70	3·11	2·45	2·98	4·	2·52	3·55	3·17	2·24	2·72	..
September .	2·73	1·49	2·42	2·31	2·06	1·81	1·$\frac{6}{8}$	1·77	2·68	3·18	3·76	3·09	..
October . .	4·72	4·22	4·82	3·11	2·77	2·92	3·$\frac{6}{8}$	3·33	4·18	2·98	2·38	4·09	..
November .	2·54	1·19	1·17	1·13	1·03	·85	1·	..	1·27	·97	·58	·78	..
December .	1·67	1·74	2·56	·92	·74	·83	1·$\frac{2}{8}$	..	1·72	1·43	1·13	·80	..
	43·12[1]	32·18[2]	40·97[3]	27·17	24·11	26·91	28·$\frac{5}{8}$	..	38·58[4]	36·24	25·66[5]	40·38	30·50[6]

[1] Average of last 8 years . . . 43·48
Average of last 6 years . . . 43·66
General Average . . . . . 46·95
[2] Average of last 3 years . . . 32·78
[3] Average of last 3 years . . 40·23

[4] Average of last 6 years . . . 42·76
[5] Average of last 16 years . . 26·09
Average of last 6 years . . . 27·17
[6] Average of last 19 years . . 36·28
Average of last 6 years . . . 33·42

Observations have not, however, been long enough continued to enable an opinion to be formed whether, as many suppose, the climate of Cumberland be gradually growing colder. The mean temperature of Whitehaven has been ascertained by Mr. Miller to be 49° 2′ for the last 18 years, and for the last 6 years 49° 22′, which indicates a contrary conclusion. It is not generally from the *great degree* of cold or the excessive fall of rain at any single period that the agriculture of this county suffers—it is more from the effects of cold *at unseasonable times*, the sudden changes of temperature, the occasional deluges of rain, and the *long continuance* of either cold or rain at periods when the crops require a different condition of the atmosphere, that they are injured, and the hopes of the husbandman disappointed.

A slight fall below the freezing point when the vegetation is full of sap does much more harm than a far lower degree at a period when the sap is at rest. But as regards the degree of moisture in the soil, such amelioration may be effected by drainage as may sensibly affect the crops, and probably the climate also. The absorption and radiation of heat is much more active and powerful in drained soils than in those which are suffused with moisture. Rain-gauges are probably better constructed now than formerly; there has been considerably less frost in late years to disturb their action, and far less snow;* they may therefore afford more accurate results. Yet, taking the journals, as chance has placed them in the writer's hands, and assuming that all have been correctly kept, the average of the seven years at Keswick, beginning with 1799, registers 70·55 inches, and the average of the seven years ending with 1850 only 57·64 inches.

At Wigton, the seven years commencing with 1833 average 40·69 inches, whilst the seven years ending with 1851 average only 33·85 inches. The Whitehaven register, beginning and ending as the last, gives 49·92 and 44·45 inches as the respective averages. These examples are not given for the purpose of working out a theory (for seven years may be too short a period for a criterion), but because they happen to be the only registers furnished by the author's friends which extend so far back, and they seem so far to bear out the idea that the fall of rain is actually diminishing. Mr. Miller is of opinion † he has discovered a place at the top of Styhead Pass, between Borrowdale‡

* Before much draining was done, the snowstorms were more frequent, far heavier, and lay longer on the ground. Thirty to fifty years ago, and before, the roads were often to cut in snow (in April, in 1799), and but very seldom now. This may have arisen from other causes than draining.

† Philosophical Transactions, 1851, part ii., p. 631.

‡ Previous to a storm coming on, a white cloud forms about half way down the mountain, and settles there for several hours, and sometimes a day or two, till the rain begins, when it disperses. This is called the Borrowdale "sop."

and Wasdale, where the enormous quantity of 211·62 inches of rain fell in 1848, and 189·49 inches in 1850. What circumstances combine to cause this unusual quantity at that particular place is not stated by him. He gives the average number of *wet* days at Whitehaven during the last 18 years as having been 197 annually.

There is a circumstance in the general conformation of the surface of the county which deprives it of a part of the heat of the sun. The whole has a general slope to the west and northwest, and therefore the rays of the sun, taken in the aggregate, do not communicate the same degree of heat as to a district facing the south.

These circumstances pointedly show the great uncertainty of our climate as a corn-growing one ;* its greater adaptation to the growth of green crops and grass, and the almost impossibility of properly ripening beans and peas. It is very justly said that "a system of cultivation well fitted to one side of the kingdom may be, and is, very precarious on the other. The folding of sheep, and the feeding off of turnips on the land, so extensively carried on in several of the southern counties of England, can never be equally successful on the heavier soils and more humid climate of Cumberland. The heavy cereal crops that would stand to the harvest and yield abundant returns on the eastern side of Northumberland, Durham, or the Lothians, would all be laid and rot on the ground in many parts on the western side of this county. Does not this great humidity of our climate in Cumberland most clearly indicate the advantage of pasture and meadow in comparison with corn?"†

The general effect of the "sea blast" on the farming of the county will be treated of in the next article; but that singular phenomenon, the "Helm wind," deserves notice here. This remarkable wind is peculiar to the mountain Crossfell, and its destructive fury is chiefly expended over the places along the western base of that mountain, and down to the Eden.

This wind occurs mostly in spring and autumn, and continues for a few days at a time. It is believed by some always to blow from the top of the mountain and down its sides on the adjacent country. Sometimes, when the atmosphere is quite settled, and hardly a cloud to be seen or a breath of wind felt, a small cloud appears on the summit of the mountain, and extends itself to the north and south. The helm is then said to be *on*, and in a few

* In the wet and misty season of 1816 the greater part of the corn was to cut between Michaelmas and Martinmas. In the parish of Dean, the heavy oat-crop of more than 150 acres stood out till the middle of the February following, and it was then useless. This was on undrained clay.

† Dickinson's Essay.

minutes the wind blows so violently as to break down trees, overthrow stacks, and occasionally even to overturn a horse and cart. The noise accompanying it is terrific, and when it happens about the ripening of the corn crops the loss is immense. At any season the grass is beat down and all vegetation injured.

It is somewhat remarkable that the western sides of nearly all the Cumberland hills (part of Bewcastle excepted), where they have a full western exposure, are almost devoid of heath, whatever the formation of the rock or the nature of the soil may be, whilst many of the other sides are clothed with that plant. The sea-breeze would seem to be acting here, and yet the heath covered large extents of those moors which were in the immediate vicinity of the sea,* previous to their enclosure.

All the trees and hedges exposed to the west and within a few miles of the coast show the effects of the storm, and incline inland.

III. Effect of Elevation on the Farming of the County.

Without attempting to account for all the causes, it may be sufficient here to show WHERE the "effect of elevation" operates to the disadvantage of the husbandman, and how it affects his interests.

The principal effect of elevation on the produce of the earth is to retard its vegetation in the spring, and to shorten the period of its summer growth. The average of 600 feet above the sea-level is given as the limit of elevation at which wheat can be grown to yield a reasonable produce. This may be correct as generally applied, but over most of Cumberland the profitable culture of wheat ceases at a degree of altitude ranging very little above 500 feet, and in some parts below that height. In the southern part of the county, where the distance is short from the mountains to the sea, and the land exposed to the fury of the south-western gales, wheat is hardly attempted to be grown so high as at 400 feet above the sea. At any greater elevation the storms which usually occur about the beginning of June, and at the end of July or beginning of August, sometimes render the whole crop nearly worthless; and on the lower levels it often happens that much harm is done by what the inhabitants call "the sea-blast." These blasts seriously injure the crops of corn, loosening their roots, and, if the grain is ripe, or approaching towards it, beating out the earliest and best portions; and it is

* There is a tradition that a fox, of very destructive habits, was often hunted to the top of the rocks near St. Bees lighthouse, and there lost, no one could tell how. A boat had been several times stationed below with men to watch his arrival, and at last he was seen to take a piece of heather in his mouth which grew on the edge, and swing himself down to a ledge of rock. The twig was cut off, and his next run was fatal; he was dashed to pieces down the precipice.

no unusual thing to find the potato-tops broke off by the ground, the stitches on the lighter soils levelled, and the turnip-plants left dangling by the ends of the tap-roots, or blown entirely out of the soil. This frequently occurs along the exposed coast from the Duddon to St. Bees, where the soils are generally of a light texture. To the north-eastward of St. Bees the coast is more elevated, and from Whitehaven to Workington the soil is stronger; the bluff headlands oppose and in some degree break the force of the tempest; and as the mountains also recede from the coast, the wind sweeps over the bulk of the wheat-growing district with a less violent force.

Further still, the coast along the Solway is low and level or with gentle undulations, which invariably run in the direction from south-west to north-east, and offer no obstruction to the prevailing south-west winds.

Wheat requires more heat as it advances towards maturity than any other of our corn crops; and the degree of summer heat is often so low on our elevated lands as is barely adequate to bring it to that state.* Even the tops of our hills, of 600 feet elevation, in the best of our wheat districts, require a more than ordinary fine season to ripen wheat sufficiently. Barley† ripens well on dry and light soils at 600 feet. It is ventured, and frequently succeeds, up to 800 feet, but is not to be depended upon as to be reckoned a paying crop at that height. Oats are occasionally sown at higher elevations, when it is wished to break up land for improving the herbage, but beyond 800 feet of altitude the crop rarely ripens well or yields much.

In the extreme north-eastern parishes, where the surface slopes gradually up from the Solway to the confines of Northumberland, oats are grown to the utmost limit of cultivation,‡ and succeed at a greater altitude than where the rise is more abrupt. In the vales of Garrigill and Nent, above the town of Alston,§ there are several farms where hardly an attempt has hitherto been made to cultivate any corn crops, on account of the altitude and exposure. The spring seasons there are backward, but when vegetation

* "In the south of France wheat is cultivated to the height of 5400 feet. In Mexico its culture first begins at the height of 2500 to 3000 feet; nay, between Vera Cruz and Acapulco, according to Humboldt, fields of wheat are first met with at the height of 3600 feet, and ascend above 9000 feet."—*Meyer.*

Wheat, of excellent quality, "is cultivated in all parts of Chili, where there is sufficient water, from the sea to a height of 5200 feet."—*Ibid.*

† In the south of Lapland, in 67° N. latitude, where there is not a trace of the culture of wheat, barley ascends to the height of 800 feet above the sea.—*Schouw's Europa.*

‡ Seven Carlisle, or 21 imperial bushels per acre, is thought a fair crop.

§ The owner and occupier of a considerable estate there told the writer, in December, 1851, that he had a great mind to break up 10 acres for growing his own corn, and that he has actually *ordered* an iron plough, there never having been a plough on the farm yet.

makes a start it advances rapidly,—the pastures are filled and the hay-grounds ready for cutting in a very short time. The hay-grass is mostly of good quality, but requires much drying; though when the season does arrive, it is generally good and not much interrupted; and when well over, winter comes at an earlier period than in any other part of the county.

The bridge at Alston is said to be 300 feet above the level of the villages of Melmerby and Gamblesby, on the opposite side of Hartside mountain, where the land is very fertile, but too high even there for much dependence on wheat.

The high grounds of Castle Sowerby and of Hutton Moor,* where seldom any grain except oats is grown, enable the harvest-men to fall back upon them when the harvests of other parts are over. The crop, however, is sometimes cut amid showers of snow or hail, and grouse are often known to come down from the mountains to feed on the stooks on Hutton Moor during snow. There is another tract of hill-land, comprising the farms of Thistlebottom, Snow Hill, and the upper part of Bolton Park, where oats and turnips are occasionally cultivated to a considerable extent, by way of renewing and improving the land for pasturage. This land lies at a great elevation (apparently at 900 to 1000 feet); the soil is a free loam on the carboniferous limestone, the highest parts capped with millstone grit. High as it is, oats usually produce a great bulk of straw, and, in good seasons, a fair return of grain upon the limestone soil; but in gloomy and untoward seasons, or on any part with a northern aspect, the crop is often to cut in a green state, sometimes so late as November, and is then worthless. The soil over the grit will scarcely feed oats or even ripen the straw in the best seasons, and some loss has been incurred in proving this fact.

There is another elevated district extending along the north side of Binsey Fell to the ancient encampment at Caermote, comprising many hundred acres of fertile soil on limestone and contorted transition rocks, where oats are the only kind of grain that can be grown. In all these districts the oats are sown as early as the season will permit, sometimes early in March. The mists of autumn occasionally hang over the crops for many days, when all is bright and sunny in the lower districts: and though it sometimes happens that the grain of the hills is more in quantity than that of the lower lands, it is always of a coarse and husky quality, and is sometimes so soft and worthless as to be fit only for carting into the straw-yards for the young cattle and pigs. It is found necessary now and then to break up these high grounds for the sake of renovating the pasture; this, with a

* Hutton Moor is from 800 to 900 feet above the sea.

tenant, is sometimes urged as a reason for ploughing land which ought to remain in grass, for all high lands should be very cautiously dealt with in breaking out of old sward, and it should never be permitted unless the tenant is of ability and prepared by lease, &c., to stand by the consequence for some years after, when the land is again restored to pasture.

IV. Description of the Ancient and of the Improved System of Farming.

Modern Farms and their Occupiers.—The average size of farms in Cumberland is less than in most of the northern counties, except, perhaps, Westmoreland and part of Lancashire. There are certainly several large farms, both arable and pasture, but these form the exception rather than the rule: as the sheep-farm of Brotherilkeld, in Eskdale (south) of 14,000 acres; Kershope, in Bewcastle, 5000 acres; Gatesgarth, in Buttermere; Coves, in Ennerdale; Askerton Castle and Winter Shields, in Lanercost; and others of the pastoral kind, in various parts of the county, containing a few thousand acres each. There are also some arable farms* of 500 and 600 acres each, or more. The smallest farms are found in villages, in the vicinity of collieries, iron-mines, and other public works at a little distance from railways and shipping, where employment in carting becomes a temptation to numbers of small farmers and poor men to congregate and compete with each other in the daily struggle for maintenance; these men overbid one another for the occupation of single fields and small parcels of land, on which to maintain their over-worked horses, and, having horses, and depending on *their* exertions for the support of themselves and families, underbid each other in the price of labour until the utmost efforts of man and horse are requisite to gain even a scanty livelihood. Very little time is spared from their daily or contract labour to cultivate their respective holdings of from 3 and 4 to 20, 30, or more acres. Horses and men are alike exhausted by their continued toil; the horses in the most abject condition from overdriving and overburthening, and the men forming the habit (in some measure pardonable) of attending well to nothing but the employ that is followed by most welcome payment at the end of the week or fortnight. This class can hardly be termed farmers, though they are occupiers of land; they are mostly persons who have been unsuccessful in other pursuits, some of whom, with the energy, constancy, and self-denial their necessities now compel them to adopt, might have retained their former more respectable occupations. Others are young men who have been servants, and

* The arable portion of Westward Parks Farm is 700 acres.

who, having been, perhaps, inconsiderately, as well as unfairly, kept too much at cartwork on farms, &c., have acquired a habit of lounging along the road, and exercising their petty tyranny over the luckless horse or horses placed under their control; so that later in life they can hardly apply themselves to manual exertion in any more laborious form. The whole of the above class are always ready to become tenants of small parcels of land, and are thus, in some degree, entitled to rank in the list of small farmers, although their farming is too often of the most wretched description. Partly through the difficulties inseparable from their position, and partly through their habitual improvidence, few only can extricate themselves from this class and enter a higher grade of land-holding. But the spirit of advancement is not dormant in all of them, and if any, by extraordinary care, happen to save enough wherewith to stock a small farm, they are almost sure to succeed; for the spirit which prompted economy and industry, the dread, too, of the miseries attending their former difficulties, increase with success, and almost ensure prosperity. Even this lowest rank of occupiers performs important functions for the community, and could not be dispensed with at present without disorganizing the rest. It is true the railways have displaced some of them, and may gradually displace more; but many yet remain who might be more comfortable and thrive better, as well as be more certain of a livelihood, if in service, than at precarious and often ill-paid road-work.

Coming into occasional competition with these last is a class consisting of small farmers, with holdings like the last, or a trifle larger, who anxiously and painfully make farming the main business of their industry, with a view to place themselves or their successors on better farms, and who, having more horse-power and more time than can at all times be profitably occupied in their own husbandry, very properly take occasional advantage of the limited earnings of road-work, rather than themselves or their horses should eat the bread or set the example of idleness.

It is pleasing to be able to record that the men of this class, if they do not aim at possessing too much land for their capital, in many instances succeed in bettering their position. From families of this class issue many of the most industrious and trustworthy servants, both male and female; their education and moral training (though still defective) being of a higher grade than that of the cottagers of the villages, which send out the great bulk of farm-servants.

From some of the small farms not placed near enough to derive advantage from the employment to be had on larger farms, the young men, partly with a view to earn a little money for themselves, and partly to see other districts and observe their customs,

go out of the county in search of mowing or harvest-work; thus, some of the young men of Bewcastle and other neighbouring parishes go over to the earlier harvests of Durham and Northumberland, and return in time to share in the labours of their own corn-fields. Others, from the small farms in the mountain vales, try their luck in the great hay-harvests of Craven; and not a few go from the bases of the western mountains to the early harvests of Furness, where their extraordinary exertions have in some seasons been recompensed with from 5*s.* to 7*s.* a day, and victuals in abundance.* Of late years the wages have been less tempting, seldom averaging more than 3*s.* per day, with meat, &c. Since more attention has been paid to draining and early and regular sowing, there has been less difference in the period of harvest between the naturally rich lands of Furness and the improved lands of Cumberland; and it not unfrequently happens now that *a week or so is the only difference, instead of two or three weeks, as formerly.*

The next to describe are the occupiers of from 40 to 100 acres, whose pursuits are purely agricultural.

In this class are comprised both tenant-farmers and the race of men so greatly prized as the stay of the country in generations gone by—the Cumberland "statesmen,"† or rather the "estatesmen." These have been described as the contented race who had no ambition or emulation to spur them to step out of the beaten track of their fathers. But this description is now altogether erroneous. It is from the savings of this class that their younger sons have been educated, and spread over the kingdom as clergymen and in other professions, several of whom have enjoyed honours and dignities in a ratio which few other counties could boast of. The successful and wealthy inhabitants of London, Liverpool, Manchester, and other commercial and manufacturing towns, are not sparingly intermixed with the offshoots from the vales of Cumberland; and the British colonies, in all parts of the world, have numbers of the progeny of the Cumberland "statesmen" among them, as successful in their vocations as the emigrants from any other country; from almost every parish of this county has the spirit of adventure sent them forth; the army and navy have had their share too, and these are some of the causes of the comparatively small increase of population in the rural parishes. Farms of the sizes above referred to are by far more numerous than any other all over the county, but there are particular districts where none of them are found.

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* No ale or beer is given to Cumberland labourers, except in rare instances in harvest.

† In a few of the north-eastern parishes (Bewcastle for instance) these statesmen are called "lairds."

The occupiers of farms of 150 up to 400 and 500 acres or more of arable land are partly tenants and partly yeomen, who cultivate more or less of their own estates. These will occupy about one half of the arable soil, though in number far below the smaller occupiers. A large majority of these are the descendants of farmers from generation to generation, some of whom are tilling the same farms, along with additions, which their grandfathers, and even great-grandfathers,* held in tenancy under the same race of owners. Others are yeomen, cultivating their patrimonial estates in whole or in part. A few are of the meritorious class who have risen from servitude or other inferior stations by continued care and industry, or in part by fortunate circumstances, to hold some of the largest farms. A very small but increasing number are of the amateur class, who, having retired from, or even while still holding more lucrative employments, indulge in, perhaps, the long-suppressed, yet strongly-implanted, wish to enjoy country life, its field-sports and fancied indulgences, not without an idea of boundless profits certain to arise from the produce of the ground.

Some of these last, who have brought superior education and ample capital, with strong enthusiasm, talent, and patience for experimenting into the field, combined with the practice of discipline and the habit of economising time acquired in other pursuits, are setting examples and instilling a spirit which must act advantageously on all around them.

Culley says in 1805, "The generality of farms are from 15*l.* to 30*l.*" per annum; "some few extend to 100*l.*, or a little more." There are many modern farms of 400*l.*, 500*l.*, and up to 800*l.* or more, in East Cumberland, and some few of like rental in the western division.

The enclosing of the numerous commons, on which so many farms enjoyed pasturage, &c., has now added to their extent, and purchases, followed by new adjustments on the greater estates, have been the means of enlarging the average sizes to what they now are. In 1823 there were 300 tenants farming on the Netherby estate, at a low rental, and with a considerable amount in arrear, a great proportion of which it was found expedient to forgive. With the resolution which only a strong mind could adopt and persevere in, Sir James Graham and his able land-steward set about revising the whole, by consolidating and enlarging the farms, and apportioning to each, where practicable,

* It is now (1852) 117 years since the ancestors of the present Mr. Mossop, of Rottington Hall, near Whitehaven, took that farm of the house of Lowther, of its present extent, at 80*l.* per annum, for a twenty-one years' lease; and on the expiration of that term contracted for another term, at the same rent for the first fourteen years, and 100*l.* for the latter seven. During the French war the rent advanced to 999*l.*, and is now something less.

an equitable share of the inferior soils, to be occupied along with the good. By a judicious selection, the number of tenants was reduced to about 140 in 1851. From 4000 to 5000 acres were retained by the owner, who expended on that and the rest of the estate upwards of 110,000*l.* in improvements, rebuilding, draining, &c., and in 1845 let most of it, and took other portions in hand to improve. Much of the inferior lands were drained without charging the tenants any interest on the outlay; and in no case is more than 3*s.* 6*d.* per acre added for the cost of drainage. The subsoil being alluvial on 8000 or 9000 acres, and a free clay on most of the rest, the cost of cutting is perhaps less than in other districts. The tiles are manufactured by contract on the property, and the 12,000,000 of them used from 1823 to 1849 were only charged with 5 per cent. interest on 20*s.* per thousand, and since that time at 16*s.* per thousand. The following extract from a Report prepared by Mr. Brown, the present land-steward, and revised by the late land-steward, Mr. Yule, a short time before his decease, will convey an idea of the state of matters on the Netherby estate thirty years ago:—

"When the present proprietor succeeded to the estate in the year 1819, it was in a most ruinous condition. The good land, which had been exhausted by repeated corn crops, was chiefly divided into small farms of from 40 to 100 acres in extent. The estate was overburdened with an excessive population; a great portion of it remained unenclosed; the farm-buildings, with few exceptions, were very bad, being chiefly formed of clay or mud walls, and thatched; whilst three-fourths of the estate was completely saturated with water, and a great extent of moss and cold pasture-land, on that account alone, remained uncultivated. The public roads were also in a most wretched state, and quite insufficient for the purposes of occupation.

"The first step towards the improvement of the estate was the amalgamation of many of the small possessions into suitable sized farms of from 100 to 500 acres in extent; the erection of good and substantial farm-buildings; the division of the land into proper enclosures by quick fences; making proper occupation roads where necessary; granting 19 years' leases to his tenantry, with improving clauses inserted therein, binding them to follow out the most approved system of modern husbandry; and lastly, establishing two tile-kilns upon the estate, to furnish tiles for the use of the tenantry.

"By these means, under able and skilful direction, and with the cordial co-operation and support of a most industrious and persevering body of tenantry, the estate has been brought into its present high state of cultivation, whilst hardly an acre, capable of improvement, remains unbroken up."

The draining proceeds at the rate of about 600 acres yearly, and some extent of land remains yet to be drained.

The improved system of cultivation adopted, and the greatly extended growth of turnip, rendered a considerable enlargement of the farm-buildings necessary for the accommodation of the annually increasing stock; and, consequently, upwards of 1000*l.* per annum has long been applied to that purpose, without interest; and the homesteads are now nearly all renovated, with

tanks, thrashing machines, and other modern improvements and conveniences on the most approved scale.

The fine domain of grazing land, forming part of the beautiful vale of the Esk, and containing upwards of 1200 acres, was formerly in a great measure let in small arable farms. This the proprietor has laid down to permanent pasture, and it is chiefly occupied by himself. Various other alterations and improvements have taken place on this estate, which have transformed it from its dilapidated and neglected state of about 30 years ago, to one of the best managed, respectably tenanted, and most productive in the north of England at the present day. There are numerous others whose estates have undergone rapid and extensive improvements of late years, and many which certainly need them; but it is uncalled for here to enumerate the many enthusiastic improvers in various parts of the county. Yet, without attempting any special selection, a few may be noticed, it is hoped without offence to the rest.

The farm belonging to Holme Eden, containing nearly 700 acres, having the advantages of a good climate, low situation, and strong soil, has been made almost to double its produce within the last 10 or 15 years, by thorough draining (2½ to 4 feet deep), judicious culture, and close attention.

The system is the four-course, with little or no fallow. The capital employed is 8*l.* per acre, and the wages paid 30*s.* per acre. The rent is calculated at the letting value. Improved implements are purchased. Little barley is grown, the soil being too heavy. The turnips, which are now raised with manure and guano, are partly drawn and partly consumed on the land by sheep. The turnip-land is chiefly sown with wheat, and produces from 21 to 24 bushels per acre. After fallows (when they are thought needful) the produce is a little more, but they are nearly excluded from the farming. A large dairy is kept, and from 60 to 80 cattle fed for the butcher on the produce of the farm. Food is steamed for the dairy cows and work horses, and a considerable proportion for the fattening cattle. Cattle with pedigrees were tried, and not found profitable; but pedigreed bulls are always kept, and a few cattle are reared from their cross with the dairy cows, which are chiefly selected for dairy purposes, regardless of breeds. A few superior heavy horses are bred, worked while young on the farm, and afterwards disposed of or turned to carting exclusively.

The sheep and cattle are flying stock, and turned over annually. In 1842, 80 head of cattle and 440 sheep were found sufficient to consume the produce of the farm; the stock of 1851 amounts to 149 cattle and 648 sheep, and only a small quantity of turnips purchased for them. Most accurate accounts are kept, classified under separate headings, and this has been done

since 1798—probably the oldest perfect farm accounts in the county.

The farm of Lowthian Gill is on the coarse grit of the new red sandstone, and the soil largely intermixed with its detritus ; a very few years ago some hundreds of its acres were valued at from 4*s.* to 10*s.* per acre ; everything about the farm is most systematically and properly conducted.

A brief statement of the proceedings of a farm on which the very best and purest stock of short-horned cattle, Leicester sheep, and short-eared pigs are carefully and judiciously reared, will show the courses of husbandry found most suitable on the soils of a low situation, nearer the mountains, viz. at Kirkoswald, the soils of which differ from the others described. The owner farms 400 acres of his estate, and feeds off a large number of sheep and cattle annually. His lower farm has been limed after draining, within the last few years, at the rate of 270 to 300 bushels per acre. A part is fine alluvial holmes, in permanent grass, over which the floods of the Eden occasionally sweep, and leave more or less fertilising sediment. The whole farm and stock are exceedingly well managed, and reflect great credit on the spirit and enterprise of the owner. Much of the corn crop (which is always very heavy) is cut with the scythe. Farm accounts are regularly kept, and the balance struck annually.

It may be objected that the statements quoted relate to men of independence, who can afford to farm high without feeling its cost, and who set examples which ordinary farmers cannot follow. This may in some measure be true. But it must be kept in mind that they belong to a class composed of men of education and reflection, who wish to improve and conduct their farms on the best possible principle, who mix in the society of and exchange agricultural information with the best farmers of all the counties of the United Kingdom, who study and investigate the information they receive by scientific rules and comparisons which the unlettered farmer cannot avail himself of, who need not spare expense in proving the benefit or inutility of the details of their theory or practice, who are equally ready to give as to receive information, whose field-practice cannot be hidden, and who have learned to despise the jeering of men who perhaps laugh at, yet profit by their examples. It may not always follow that the best educated men make most money by farming, for there are money-makers and money-losers in all classes and in all pursuits ; but it is unquestionable that well-educated men are better able to conduct their farms properly, and, above all, are able to keep accounts * and to know at any time how their affairs stand as to profit and loss.

* The disability of the general run of farmers to keep accounts, places many a man's affairs beyond remedy before he is aware of it; the leathern purse or canvas

"Book-farming" is still held up to ridicule by the few who cannot read or understand books, but is eagerly investigated by the many young farmers who are anxious to know more, and farm better, than their fathers have done. 150 years ago as few farmers * *could* read a book, as there are now to be found who *cannot*. It is claimed for the farmers and yeomen of the extensive barony of Gilsland and its surrounding neighbourhood that they have profited as farmers by their superior education. The like may fairly be applied to Holme Cultram, and, in fact, to the educated farmer, wherever he is found. For the farming of the present day is as much in advance of that of former times as is the education, and it appears on the eve of being rapidly advanced further. The great drawback on the farmer's education, as a class, is the little intercourse the sons enjoy with the rest of the world from the time of leaving school to the period of active responsibility at the head of a farm. It too often happens that the son is kept at work, instead of taking his turn occasionally from home on the business as well as on the work of the farm. However easily and expensively the learning may have been acquired, it is very readily lost at that age, and the *man* often pays dearly for the thoughtlessness of *youth* respecting the application of his school education to that of the farm.

Leases, though now more prevalent than formerly, are by no means general, but are frequently substituted by agreements, and those again by the conditions of letting, signed by the contracting parties. Verbal contracts are by no means rare, where mutual confidence exists; and if disagreements happen, the custom of the county is appealed to by arbitration. During the 36 years' stewardship of Mr. John Benn on the Earl of Lonsdale's Whitehaven estates, ending in 1850, very few written contracts for farms existed among the numerous tenantry, and rarely any misunderstanding took place. Among the tenantry of the Earl of Carlisle, too, not a lease exists.

In the case of strangers coming on to the estate, agreements are usually signed, but very seldom acted upon. Of this large body, all who are disposed to act uprightly find themselves perfectly secure under what they consider as terms from year to year only; and one of the old tenants lately told the writer that the tenantry considered they held their farms *from father to son*. There are numerous examples of this honourable confidence;

bag being full or otherwise being the only indication of money gaining or money losing with many.

* There is an inscription cut in stone, in the wall of a house at Hutton Moor End, which tells plainly of the state of education at the date inscribed, viz.:—

"This bvildings age
These letters show
MDCCXIX
Thovgh many gaze
Yet few will know."

where it does not exist, even leases can be quietly and almost imperceptibly—but, unfortunately, very surely—evaded, if a tenant be dishonestly inclined. The stipulations, which in most cases rule what is held as the custom of the country (before alluded to), usually correspond with five or six years' course.* These are, for entry on the arable farms, chiefly at Candlemas, and a few at Lady-day; but, on sheep-farms, almost invariably at the latter period. The usual requirements are half-yearly payments; payment of all rates and taxes, and performance of all parochial and parliamentary offices, by the tenant; keeping all in repair except walls, roofs, and main timbers; not having more than one-third of the arable land under corn-crop; for fallow or green crops between every two corn-crops,† and sowing the latter crop down with clover and grass-seeds for three years; for not mowing the grass-seeds and clover twice in the first year, nor again in the same course; for not ploughing meadow or old grass-lands; for keeping a full stock of cattle, &c., as in former years, to the end of the term; for spending the vestures on the premises; with various modifications of these several conditions to suit circumstances and localities; a clause for re-entry on the non-fulfilment of any of the stipulations; and mostly with a general clause requiring the farm to be managed according to the rules of good husbandry and the "custom of the country." This custom varies, in some few localities, to a five years' or other course.

It has become more general lately to make the whole year's rent due at the termination of the first half-year, but to excuse payment till the regular time if all goes well. Meadow-hay is scarcely ever allowed to be sold, and seed-grass hay but seldom, unless the tenant provide an equivalent in extra manure. Corn-rents occur in some few cases; but, in no case within the knowledge of the writer, does the tenant stipulate for an interest in unexhausted improvements, beyond his outlay for fallows and grass-seeds, or something of old-standing custom. Terms are commonly for seven, nine, or fourteen years. Some few introduce penal clauses for over-ploughing, over-mowing, suffering drain-mouths to choke up, &c. &c.; but a proper selection of tenants of respectability (now when the choice is so abundant), with sufficient capital, at reasonable—not at adventurous—rents, for leases of fourteen to twenty-one years, with covenants for

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* The five years' course prevails more in the east, and the six years' course in the west of the county.

† Housman, who wrote on Cumberland in 1800, says "The most general rule is to sow from two to five or six white crops in succession; and there are some instances where land has been ploughed and sown with corn for time immemorial."

"The ploughman drives the (pair of) horses himself with the utmost ease, by means of cords fixed to the bit of the bridle, and will plough an acre a day. This method has not been practised above thirty years."—*Ibid.*

proper payments, and for reasonable and well-defined quantities and qualities of manure, or of hay and straw in lieu, to be left, would put many of the complicated clauses of leases on a more simple footing, and be more efficacious for both landlord and tenant: always admitting that a MUTUAL DETERMINATION to continue friendly is of the utmost importance to both parties.

Since draining has enabled turnips to be grown on the better class of clay-lands, bare fallows are very properly much less resorted to than formerly. From the peculiarly moist climate of this county, seasons occur now and then when if fallows are not, or cannot be, duly attended to in early spring, on account of turnip-sowing, &c., they cannot be properly worked afterwards, as on the clays situate a few miles from the shore. The uncertainty of obtaining a fallowing season suitable alike for the destruction of both annual and perennial weeds, has, and must still more forcibly, urge the necessity of perseverance in draining, in order to increase the quantity of land for growing green crops, and to dispense with the expensive and dilatory bare fallows.

Mr. Ferguson, of Harker Lodge, and Mr. Harris, of Greysouthen, have both rather extensively practised fallowing for two years or more in succession, and by means of that and of deep ploughing have obtained immense crops of wheat; the latter with extra allowances of lime * alone, and both, of course, after perfect drainage. These examples, though excellent in themselves, are no guide for the tenant-farmer; and we are glad to be able to record that the most intelligent farmers are using great exertions to substitute green crops for bare fallows, wherever there is a probability of raising a fair crop of turnips. In the place of bare fallows for wheat, many spirited farmers now have the fallows (on land where a wheat-crop is doubtful) completed as early as possible, and sow down about Lammas with rape and seeds; and since the introduction of guano and improved implements for cleaning land this practice is extending every year. This crop yields some return in the first year, a larger in the second, and does not exhaust the soil by taking away any of the crop more than does common pasturage.

The importance of turnip-growing forces itself on the attention of the farmer more and more every year. Bailey and Culley say, "Turnips were first cultivated in this county, to any effect, for the use of cattle, by Philip Howard, Esq., of Corby, in the year 1755: his first essay was drilled at 4 feet distance, the crop amazingly good." He "continued to grow them at 2 feet and 2½ feet distance, with constant success, for eight or ten years before any farmer followed his example; at last, Mr. Collins, of

* 450 to 500 imperial bushels to the acre.

Wetheral, made a trial, and succeeded; others soon followed him." It took several years to spread the culture over the county: for in 1793 the first field-crop,* amounting to 4 acres, was grown in the fertile vale of Bassenthwaite, and several years elapsed before any one followed the example there. Indeed, the turnip-crop did not become general till within the last twenty-five years, since when it has gone hand in hand with tile-draining; and now, no farm where a plough is kept is, or ought to be, without more or less of the crop. The method of preparing the ground for turnip-growing is much the same in this as in most other northern counties, having for its object the clearing of the land from weeds and the perfect pulverization of the soil. The sowing† takes place as soon after the 24th of April as the weather will permit, beginning with the swedes, which are commonly all sown by the middle of May. The next in succession are the hybrids, greentops, yellows, and globes, and all are attempted to be finished by the middle of June.

The (stitches or) drills vary from 27 to 36 inches asunder, the average being 30 inches, and hardly an acre can be found sown on the flat; the approved allowance of manure is 12 tons, and very frequently 2 cwt. of guano per acre in addition. Of course, many apply far less manure, and some give more, whilst numerous artificial preparations, bones, &c., are resorted to in other cases.

The seed is deposited in line,‡ chiefly by horse-drills; and after drill-harrowing and hoeing the edges off, the singling is done by boys or women, who creep along the drills on their hands and knees, placing a finger on the finest plant at the proper distance, and sweeping out all the superfluous plants up to the next, at a grasp or two, and so on. Where properly taught, three will single an acre in a day, with greater speed and accuracy than with the hoe, as formerly. Deep cultivation is of essential service to this crop,§ and especially on drained soils, to assist the water to escape into the drains instead of stagnating in the soil, and to allow the fibrous roots to penetrate in search of the nutriment existing in, or carried down into the lower soil by rains.

In this moist climate the soil can scarcely be drained too dry

* By Mr. Atkinson, of Bassenthwaite Haws.

† Many farmers raise their own swede-seed, and are very particular in selecting roots of the finest shape and quality for transplanting for that purpose. Some raise for sale also; and very few grow more than a single kind of seed, to avoid hybridizing.

‡ A saving of seed, and a great saving of time in singling, will be effected when drills come into use for dibbling three or four seeds at regulated distances.

§ A subsoiler, formed by taking both mould-boards off the double mould-board plough, is a useful implement to run along the drills, as the *last* operation of the season, at 8 or 10 inches below the drill bottoms.

for the turnip-crop; and where it is dry, and the manures liberally applied, the bulbs attain a great size, if duly thinned to 12 or 15 inches apart. Advocates are not wanting for greater distances, but the majority are more apt to leave the plants at 8 or 10 inches asunder, and materially injure the crops, unless on very heavy or imperfectly drained lands which cannot support heavy crops. All seem agreed that the middle of October is not too soon to commence storing swedes: this should be done in dry weather, if possible, for the bulbs invariably keep best when stored dry, and better still if not allowed to remain exposed over night after being cut; the whole work goes quicker on, less injury is done to the land by carting, and more time is gained for wheat-sowing.

The usual form of storing is the long ridge of 6 or 8 feet wide at the bottom, tapering to an edge at the top, and covered with thatch. When the crop is abundant, it is usual to plough down the tops immediately after they are cut off.*

When the proportion of turnip-crop is too small for the consuming stock, it becomes needful to feed with the tops while they continue fresh; and, in the absence of direct experiment, it is yet undecided whether feeding cattle with the green tops or ploughing them in is the better course.

Large quantities of turnips are now consumed on the ground by sheep and some by cattle; a few are at the pains of having turnips cut for lambs and young sheep, giving them in troughs, and find great benefit from it, as the sheep thrive better, and leave little or no waste of the roots. In consuming on the ground in the growing state, or drawn and given loose on the green sward,† the waste of turnip-shells and skins amounts to as much as the cost of cutting, and the sheep seldom do as well. The parishes of Brampton, Irthington, Hayton, Lanercost, Wetheral, and some portions of the adjoining parishes, contain a great extent of dry soil, or which has required little draining, forming a district of excellent turnip and barley soil, and, perhaps, in few parts of England are the crops more abundant or better managed.

A few days after the Falkirk September tryste, the parties from a distance, who are accustomed to purchase sheep there for turnip-feeding, assemble at Brampton to meet the turnip-growers,

* To aid in pressing the tops down into the furrow, a drag-chain, with a weight at the end, is in use on the Lowthian Gill Farm and a few others. It is fixed on the plough-beam, and works opposite the fore part of the turning furrow.

† It has lately been observed that on light land, where turnips have been repeatedly grown, or been given to sheep or cattle on the stubble or lea, or where turnip stacks have stood in the previous year, the plants are very subject to fork into "fingers and toes." This is now found to occasion some inconvenience, as the maggot which causes the disease is said to continue about three years in the soil; and where it is known to be, it is useless to attempt growing turnips.

and treat with them for their crops. Large bodies meet annually on these occasions, much business is done, and the prices there agreed on regulate the rates at which sheep are kept on turnip over a large district. It is usual for the sheep-owners to send their own shepherds to attend to the sheep, the owner of the turnips finding nets or hurdles and hay as may be agreed on.

Around Penrith large quantities of turnips are grown for sheep-feeding; and, indeed, in every parish over the whole county, more or less are grown for that purpose.

Small quantities of mangold-wurzel are grown on many farms, for spring use, as this root keeps well to a late period of summer, if carefully stored without injury by frost or rain.

Few field cabbages are grown, and for no good reason, as there is plenty of soil adapted for this crop; and Robert Brisco, Esq., has proved, in 1851, that sheep throve well on a few acres of his excellent crop, part of which were of the red kind.

Carrots are grown to a small extent on dry soils, or on peat, and large crops obtained on the latter; but neither these nor any roots keep well if grown on peat or other light soils.

For some time after potatoes were first grown in Cumberland, they were cultivated entirely by the spade, in beds; and the crop remained in the ground to be taken up as wanted. As the growth extended, the plough was used.* The manure, having been brought to the field in "hots" or "creels,"† was laid down on the stubble. A furrow was drawn by the plough, and women attended with swills (baskets), from which they put in the manure by hand, and planted the potatoes. The plough waited till this was performed, and then covered the seed by another furrow, a third was laid against it, and the process repeated till enough were planted. No weeds were taken out, and it may easily be imagined in what state the land would be for receiving the next crop!

In 1805 Bailey and Culley state that "potatoes are cultivated in one-bout ridges by almost every farmer, not only for the use of their own families, but for sale, where the situation is not too distant from a market. It is only upon the estate of Sir James Graham,‡ at Netherby, that they are applied to feeding cattle and swine; and by Lord Muncaster to feeding cattle, who also gives them to his horses." Since that date the cultivation had

* About seventy years ago people went from far and near to view the large crop of potatoes annually planted by Laird Dodgson, father of the present Mr. Dodgson, of Roanstrees, in Bewcastle, he being the only one who planted more than he could plough in a day!

† Wooden or basket-work panniers slung over horses' backs. These were emptied by pulling out wooden pins, which secured the bottoms of the panniers. The person stood close to the horse's heels, and, reaching forward both hands, pulled the pins out and let the contents fall. If both pins were not pulled out at the same time the full side was sure to pull the empty side off.

‡ The late Baronet.

been widely enlarged, down to the period when the potato disease visited England.

But for the last few years people have been more wary in planting, and the result has been cleaner lands, under an extended turnip culture. Still the disease has neither been so violent nor so widely spread in East Cumberland as in the west; many parts of the east having considerable quantities to dispose of annually, and the west having to purchase. The virulence of the disease seems in the way of abating, and the crop is being gradually extended.

Although Cumberland cannot be said to be a wheat-growing county, much larger breadths are now sown than formerly, and still large quantities are imported. Bailey and Culley say "wheat is a modern production here," and "it is not more than 40 years since summer-fallows for wheat were first used." They also say, "the wheat that is sown after turnips or clover is trifling, the main supply is from summer-fallows." Wheat is not yet sown after clover, except for experiment, and does not succeed. Summer-fallow has been the usual preparation for wheat, and much mismanagement committed in that way, till the extension of turnip culture on drained lands. And now the turnip-land wheat almost rivals in extent that of the fallows. About three imperial bushels of seed are sown or drilled to the acre; commencing with the manured fallows, about the 1st of September, continued to January on the turnip-lands, and ending with the spring wheats in April.

The seed is commonly pickled before sowing, with sundry preparations, such as arsenic, blue vitriol, lime, &c., to prevent the smut-ball. Some prefer its being slightly dried on the drying-kiln, and this process, when cleverly managed, is said to be effective. A low degree of heat above ordinary temperature is sufficient to destroy the sporules of the smut, but an unskilful or careless operator would be apt to overheat the corn and destroy its germinating properties.

Early cutting of wheat (that is, previous to the head being turned down) is on all hands admitted to secure a finer sample than the old method of allowing it to die on its feet.

Thirty years ago the estimated average produce was 18 * imperial bushels to the acre. It may now be reckoned about 24, and bids fair, under the great use of artificial manures, drainage, &c., to be yet increased. On first-rate soils from 30 to 40 bushels, and more, per acre, are grown in favourable seasons.

Bigg, or bear, was commonly grown in former times, but has been superseded by barley. This is sown after a turnip-

* So little as 12 to 16 bushels have frequently been known on the undrained clays, after an expensive summer fallow.

crop,* on soils which are too light for wheat, and is found to be the best nurse-crop for young seeds. The produce may average about 35 imperial bushels per acre. A great part of this crop is used for bread in the farm-houses—the labouring men who provide their own victuals commonly using wheat-bread. The best of the barley crop is bought for malting, but a great portion of the malt used here is the produce of other parts. In former times malting conveniences were numerous over the county, and the writer distinctly remembers the country maltsters riding about on horseback, seated on long pads,† with a number of "pokes" or bags of malt under them, to deliver, as per order, to their customers. Ale and beer were then brewed in the farm-houses, where now there is hardly such a thing done—the malting and brewing being both carried on in large concerns in or near towns.

Oats generally compose half of the grain-crop of the farm, they being almost invariably the first crop of the course. On high-lying farms, some of which have no barley soils, they constitute the entire crop. The potato-oat ‡ is the kind generally sown, and the quantity of seed from five to six imperial bushels per acre. The produce is extremely variable; from 24 to 60 bushels or even more per acre, the average being about the same as that of barley. A great quantity of oats is ground into meal, and made into porridge; and this, with milk, bread, and sometimes cheese, constitutes the breakfast and supper of the chief part of the farm households in the county. Thin oat-cake is the family bread of most farms in the extreme south-west of the county, and is more or less in use all over it, except in towns.§

Rye is very little grown, except in small patches on peat-soil, or on sand which may be thought too light for other corn crops. An inducement to grow rye is the higher price the straw bears for saddlers' use.

Grain is cut chiefly with the sharp hook and the sickle; but

* On dry land, in high condition, Mr. Isaac Atkinson, of Cockermouth, obtains heavy crops of barley on the ley furrow.

† In those days the pillion was in general use for conveying the farmers' wives on horseback behind their husbands.

‡ This oat is said to have originated from a single plant, found growing in a potato-field in Cumberland, in the year 1788.—Lawson, of Edinburgh.

§ Eden, in his 'History of the Poor,' says, "About the year 1740, so small was the quantity of wheat used in the county of Cumberland, that it was only a rich family that used a peck of wheat in the course of a year, and that was at Christmas. The usual treat for a stranger was thick oat-cake and butter. An old labourer of 85 remarks, that when he was a boy he was at Carlisle market with his father; and wishing to indulge himself with a penny loaf made of wheat flour, he searched for it for some time, but could not procure a piece of wheaten bread at any shop in the town."

Thick oat bannocks were said to be the earliest in use; then bigg and oat mixed. "Bannocks o' barley-meal" were celebrated in song in the last century, and wheat followed last.

the scythe is yearly becoming more of a harvest-tool, as people get acquainted with its uses and merits. In a discussion on the relative harvest merits of scythe and sickle, at the Carlisle District Farmers' Club in 1851, Mr. Thomas Gibbons estimates the cost from his own experience, and found mowing to cost 5*s.* 5*d.*, and reaping 8*s.* 9*d.* per acre. He stated that, when reapers could be had for 1*s.* 6*d.* to 1*s.* 9*d.* per day, he would shear his wheat and mow the rest; but when 2*s.* 6*d.*, he would cut all with the scythe.

Mr. John Birrell gives his estimate still more in favour of the scythe.* Other circumstances are in favour of the scythe which do not appear in these estimates, for mowing need not stop in dewy mornings or light rain, the additional straw is valuable, and the crop is ready for the stack three or four days earlier than when cut with the sickle. About the beginning of the present century a company of Welsh militia were quartered in Whitehaven in the autumn, and, being chiefly of the rural class, were permitted to go into the country during harvest, and to use the scythes they providently brought with them. Wages being high through a deficiency of hands, they cut a considerable breadth of corn on various farms. Several of the farmers, appreciating the workmanship, attempted to use the scythe in imitation of the Welshmen, but not having suitable implements, or not having acquired the necessary expertness in their use, were not successful teachers to the rising generation, and the practice gradually fell off, and was abandoned for many years. Its use seems now recovering, and bids fair to oust the sickle and hook from all the corn-crops, except where full crops of young seeds interfere.

Corn-stacks are commonly built of the circular form, and the thatch secured with neat straw ropes or tarred cord. The latter is preferable for despatch, and with care lasts two years.

Many of the stacks are placed on stone pillars with caps, to prevent damp from the ground and vermin. The set of pillars and caps are furnished, rough dressed, at about 10*s.* for each stack. A kind of stack-barn, invented by Captain Robertson Walker, of Gilgarron, and used by him for the last four years,

* Scythe.

	£.	*s.*	*d.*
Eight mowers, at 2*s.* 6*d.*	1	0	0
Eight women, at 1*s.* 8*d.*	0	13	4
Eight boys and girls, at 10*d.*	0	6	8
Four bandsmen, at 2*s.* 6*d.*	0	10	0
Two stookers, at 2*s.* 6*d.*	0	5	0
Horse-rake, 4*d.* per acre	0	4	0
Twelve acres, at 4*s.* 11*d.*	2	19	0

Sickle.

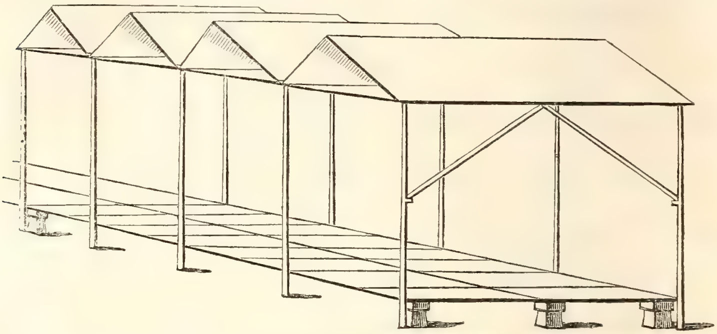
	£.	*s.*	*d.*
Two men, at 2*s.* 6*d.*	0	5	0
Two women, at 1*s.* 8*d.*	0	3	4
One acre	0	8	4

Difference, 3*s.* 5*d.* per acre.

Wages are generally lower where these experiments were conducted than in other parts of the county.

is approved, and has been copied by a few others in the county.

The following sketch will convey an idea of its construction :—



Portion of Stack-yard at Gilgarron.

The pillars of these erections are of cast-iron, the short foundation pillars of stone, and the framing and roofs of timber. The compartments are 16 feet long, gableways, by 13 feet wide, and the cost of each 8*l.* 2*s.* 6*d.* With wooden pillars instead of iron, the cost would be about 30*s.* less each.

The inventor says, his stackyard, composed of 26 compartments, " has been found to answer every purpose of economy, compactness, despatch, and perfect security to the corn from weather and vermin."

Of course the dimensions of the compartments, whether for hay or corn, can be constructed and varied according to circumstances.

In the husbandry of old times, when the land was cropped with corn year after year, and became unmanageable from the excess of couch and other weeds, peas were sown, with the triple view of smothering the weeds, improving the land, and obtaining a crop where no other could be expected to grow. We may fairly infer that the expectation would be frequently disappointed in all the aims. No manure was given, and the pea-crop was followed by oats, and laid to grass without seeds. It would be singular if disappointment did not again occur.

This most opprobrious of all recorded husbandry is now out of date, and almost out of memory. The culture of both the pea and bean crop is nearly abandoned, as unsuitable to a climate where so much rain falls.

Spring vetches are sown in small quantities over most of the county, for horse-food in the spring or for dairy cows. In the high-lying township of Birker, where most of the milk cows are depastured on the mountains,* vetches are constantly grown and

* Butter of the very finest quality is made from these heathy pastures.

given to them at milking-time; and the poor animals soon learn to be very regular in their attendance at home at those hours. In the neighbourhood of Ravenglass and Bootle vetches are occasionally sown among ley oats—the mixed crop is cut, threshed, and given to horses, or ground for pigs and fat cattle. The vetches do not seem to injure the oat crop, and the oats constitute a support, which enables the vetches to ripen sooner than when sown as a separate crop.

In former times hemp and flax were grown in small parcels on almost every farm (as the common names* of many fields still testify), and formed part of the employment of winter evenings to the household: the male branches platting the hemp into cordage and scutching or dressing the flax, while the females spun part of the latter into thread for home-made linen,† and prepared the rest for sale as lint, to be spun by others. Cottagers were allowed to sow flax on the neighbouring farms, on giving harvest-labour in return; the seed was saved, and sold by the women in the market-towns by the hoop-measure.‡ From this the home-grown seed was called "hoop-seed;" and that of foreign growth, from being sold by weight, was termed "pound-seed," and brought a higher price. The growth of flax was partially continued down to the present century, but was finally obliged to give way, along with its manufacture, before foreign competition and machinery.

Gardens are common appendages to the farms, and orchards partially so. The parishes of Irton, Muncaster, and Crosthwaite contain many good orchards, where fruit is grown for sale. In Bassenthwaite parish field-orchards were tried a while ago, but abandoned on account of the extensive depredations centered on them.

Manures are now assuming the importance they are justly entitled to in rural affairs, and farmers turn their attention to many sources for obtaining them now that were entirely overlooked or unknown a few years ago. The best farmers also exercise more judgment in preparing, mixing, preserving, and applying the manures produced on their farms. Many farms now have tanks for collecting the valuable liquids which, till lately, all ran to waste, and many more still require them. The produce of these tanks§ is applied to grass-lands, to Italian rye-grass, and other soiling crops, and to saturate the dung-heaps. Capt. Robertson Walker has set the example of covered dung-

* Hempgarth, linegarth, hemp-headling, &c. Hemp-dubs and line-dubs, and their uses for steeping, are still remembered by many old people.

† The bracken (fern) was gathered and burned to make potash for bleaching the home-made linen.

‡ The "hoop" contained six quarts, and the name was derived from its being made of a broad wooden hoop in the form of a tub.

§ Some doubt if the benefit is equal to the labour of distribution.

hills, which effectually prevents the waste occasioned by the frequent rains to which this climate is so liable. He also pumps the contents of the tank over them, and, by having the accumulations regularly spread and mixed, fermentation is checked, and the manure cuts out in excellent preparation for the crops. Others have seen and estimated the benefits arising from these roofs, and have copied the example. There is an advantage attending the roofed dungheaps which has not yet been much taken into account: with very trifling additional cost they form warm and comfortable pig-yards and poultry-roosts, sparing the cost of part of these erections in a separate form, while both pigs and poultry assist in mixing and consolidating the ingredients, and they suffer not a grain of corn or other edible seed to remain in the mixture.

The different kinds of farm-yard manures contain the various ingredients of fertility in different proportions, and therefore require to be mixed, otherwise the land might be, and often is, unequally benefited, though receiving equal quantities of manure. When the manures are applied in a well-mixed state, the crops derive greater benefit from the choice.

Manure is often carted out into heaps in the fields in winter, and is partly mixed in that operation. Too often these heaps remain uncovered till spring, during all the changes of weather, and the contents suffer great waste both by washing and evaporation. Fresh cow-dung sustains a loss of one-fifth of its solid matter in about six weeks of ordinary winter weather, when uncovered; and horse-dung, by remaining exposed for two or three weeks, usually loses more than three-tenths of its weight. Two or three layers of soil in the heaps, and a covering of a few inches of soil, is all that is actually needful for preserving the greater part of the ammonia and saline ingredients,* and these the most easy-drawn farmer may surely make up his mind to apply. Farmers at a distance from the seaports have double reasons for being careful in preserving the qualities of their home-made manures; they cannot have the cheap manure which the Irish coal-vessels bring over as ballast; nor can those at a distance from any towns send their carts for the town manures; therefore they have only their own resources to rely upon, aided by guano and the more expensive preparations they risk† the purchase of. Those near towns avail themselves largely of their privileges in this way, and some are therefore allowed to follow the five-year course.

* The proportion of a quart of sulphuric acid to 16 gallons of water forms a suitable sprinkling for a manure heap before covering up, to assist in retaining the ammonia.

† Nesbit has published a series of easy tests for guano, which any farmer may apply.

Guano is extensively used over most of the county; bones sparingly; lime is a common product from one end of the county to the other, and was very largely used before the introduction of guano, but is little used now; a great deal of good has been effected by its use, and some harm by its abuse. When the enclosures of the numerous commons so rapidly succeeded each other, from 1780 to 1825, and large crops of grain were commonly obtained after liming the virgin soil, lime was abundantly applied to all soils without discrimination. There were scarcely any soils which, on breaking up, did not respond abundantly for a few years after a heavy dose* of lime; and when they began to diminish, a fresh application of lime was expected to be as efficacious as the first. On dry or well-drained soils this did no harm, and, if not applied too soon after the first, it was beneficial; but on wet clays, weak sandy soils, and light peat earths, much injury followed this second or third application. The wet clays were *mortarized* (to use a coined term), the light soils worked and disintegrated till their texture was destroyed, and both rendered almost sterile† until drained and re-cultivated with manure and no lime. Composts of lime and soil, so common when Bailey and Culley wrote, are little used now, other manures being better and cheaper.

Tradition says seaweed was much used for manure in former days, and "tangle-dotes" have been allotted on some parts of the coast,‡ where each farm had its separate right of collecting the weed. Perhaps some diminution may have taken place in the production of this useful manure,§ as only small quantities can now be had along the coast. Some farmers neglect to use these privileges, and others are very attentive to them.

Of the large extent of moor and heath broken up within the county, much has been reclaimed by paring and burning, the ashes being spread and ploughed in along with lime, varying in quantity from 150 to 300 imperial bushels per acre. A great deal of this was sown with wheat in the autumn, after the paring, on the first ploughing. On the peaty or very light soils, or on high situations, oats were sown, and almost invariably abundant crops resulted; some followed with oats and seeds, and others scourged by repeated crops till the soil was exhausted and left for their successors to renovate; some had an idea that the heath could not be destroyed without paring and ploughing, and put themselves to great expense to accomplish

* From 12 to 14 carts, of 18 imperial bushels each, equal to about 250 per acre.

† Considerable tracts on Inglewood Forest, Botton Pasture, and other late commons, might be instanced as examples.

‡ Allonby, &c.

§ In the Isle of Man potatoes are grown without any other preparation, on some farms, than merely ploughing in the sea-ware on the greensward.

what lime alone on the surface will safely effect where the soil is tolerably dry.

On most of the ancient enclosures the fences are of earth, raised by repeated castings of a few inches of soil at a time, till they have reached the height of 4, 5, and some 6 feet, with growing wood* of various kinds on the top; many of these are crooked, and dispose the fields into awkward shapes, and render them inconvenient for working. On the more recent enclosures the hedges are straight, and mostly planted with white thorn.

It is no uncommon thing to find fences on inferior soils which have grown thorns pretty well for a few years after being planted, yet afterwards wither at the tops and cease to grow; this is not owing altogether to the inferiority of the soil, but, in a great measure, to the limited space the roots have to work in. The roots cannot descend into or draw nourishment from the wet clays beneath them; their communication with the fields on each side is cut off by the ditches, and the stems are bolstered up to an unnatural height by the castings on the sides till the thorns cannot thrive. This is not the case where even the poor soils are dry enough to permit the roots to penetrate out of the way of the hedger's spade; this at once points out the necessity of draining to enable the hedge-wood to grow. In the immediate vicinity of the sea-shore, where the soil is not adhesive and stones are plentiful, the sides of the hedges are breasted with rows of stones leaning one against another, in the manner of the ancient feather-form masonry of the Egremont and Burrowwalls Castles; the centres are filled with earth and stones. These are strong and good fences when well made.

Several of the level moss-lands of the Abbey Holme, and some in other places, are divided by narrow canals or water-dykes, which require scrupulous cleansing annually, and are not devoid of danger to cattle when depastured there.

Along the bases of the mountains and up their sides stone walls are more common, and a rather unique and ancient kind of stone fence may be seen in the vicinity of slate and other laminated rocks, which is formed by placing thin flags of it upright and edge to edge. In many places, where sand predominates in the soil, the furze (Ulex europæus) is reared on the hedges, and makes a good fence when clipped annually. A considerable length of hedge near Lorton is planted with larches in place of thorns, and they seem to answer their purpose well so far.

Another novel kind of fence, topped with growing broom (Genista anglica), may be seen in the parish of Millom, and, being

* A keen spring frost, which occurred about thirty years ago, is said to have occasioned the death of nearly the whole of the sweet willow (*Salix pentandra*), which was so common in meadow hedges.

clipped, makes a close evergreen hedge. Gates are now in almost universal use in place of the time-consuming gap-rails, which are only admissible where the gaps are little used. Pattern for gates is of small importance, provided they are strong and firm, light at the fore-end, high-made and high hung, work easy, fasten readily, and answer the purpose they are placed for. All gates on the same farm should be of the same length, and all hung and fastened in the same way, so that all may fit any of the gateways on the farm, and the weaker or old ones removed to where they will be least in use. Where young horses are depastured, the upper bars should have hoop-iron nailed along them, to prevent their being gnawed; and a bar, laid flat on the upper edge of the top bar, is found to add more to the strength and stiffness of a gate than three or four uprights.

The detailed census of 1851 not having yet been made public, no correct means are at hand to show the number of hands employed in agriculture, or any of its branches. In 1841 the persons engaged in the two great sources of production were stated* as more than two-thirds of the entire population being employed in agriculture.

Notwithstanding that in some parts of the county some small farms have been thrown into larger ones, it is well known that many more hands are now employed on the same extent of land than were so thirty years ago. At present the labourers are in full employ, at wages rating from 1*s.* 10*d.* to 2*s.* 6*d.* per day; women at 10*d.* to 1*s.* Cottage rents vary considerably, according to their proximity to mines and other public works. In the Abbey Holme, a purely agricultural district, ordinary cottage rents are as low as 30*s.* to 50*s.* yearly. In the neighbourhood of Cleator and Egremont, where hands are required for mining, smelting, mill-work, &c., rents vary from 50*s.* to 84*s.*, and some higher still; and by a singular anomaly, labourers' wages are highest where cottage rents are lowest. The allotment of garden-land is scarcely known here, for many of the labouring poor possess gardens along with their cottages; and some agree with their employers for permission to plant a row or two of potatoes, &c., in the fields.

Women-labourers are employed as in most other counties, in picking weeds, hoeing turnips, hay and corn harvesting, pulling and topping turnips, and a variety of lighter labours. Driving carts has been a common employment for them till lately, but they are now mostly relieved from that, and their whole out-door work is much circumscribed, without any want of employment for them being felt. The carelessness and incapacity of many

* Blackwood.

female servants, especially as regards household duties, have long been a just cause of complaint among farmers; and their want of training in the cottages of the poor, from whence they spring, is not likely to remedy the evil without the intervention of more competent teachers. There are many honourable exceptions, and several steady, industrious servants of both sexes, who regularly deposit a portion of their earnings in the Savings Banks; and this habit ought to be encouraged by masters.

Emigration has been draining a portion of our labourers away for many years, and the current still continues, at present setting towards Australia.

Implements.—It is believed that the plough has passed through a number of transformations since the days of our Saxon ancestors. In their time it was ordained that no one should be permitted to guide a plough who could not make one. These transformations we are unable to trace, but in 1805, when Bailey and Culley reported on the farming of Cumberland, they stated that "the plough of this county is the swing plough." This, with the modern improvements, is the plough of the county at the present day. The greatest improvement is the substitution of iron for wood, and Wilkie's plain and simple pattern is the model from which most of the ploughs are made.

Almost every parish has its plough-maker, who watches the agricultural exhibitions, ferrets out and compares the alterations and improvements, adopts and applies such as his judgment or fancy approves, and has them tested by some favourite ploughman before submitting to public scrutiny. Most of these home-made ploughs are simple and light in construction, yet strong enough for the stiff and stony soils they encounter; are neatly finished, and fit to compete, in the hands of a Cumberland ploughman, in any trial-field in the kingdom.

The plough of ancient husbandry required but the work of a day to construct, from the growing timber to the finished implement. It was fastened together with wooden pins, had its mould-board of wood, and all the iron in its composition was the coulter, the sock, and sometimes the bottom plate. Wooden ploughs, of excellent construction, may still be seen in use, and the only objection to them is their greater liability to decay.

Double mould-board ploughs are found on nearly every farm, and are much approved in turnip husbandry, &c. The turnwrest is also in use for hill-side work.

Of harrows there are a multitude of patterns and names, with probably less difference in effect than in any other kind of implement.

"Thrashing machines, drills for sowing the various kinds of grain, and horse-hoes," are said by Bailey and Culley, in 1805, to have not "yet found their way into this district."

The thrashing machine* is a modern implement, and is become very general over all the grain-growing parts of the county. It is rather singular that in a county where streams are so numerous water-power should be so little applied to work these machines; for it is certainly available in scores of instances where horses are used. In West Cumberland, out of the 306 thrashing machines in use in 1849,† only 71 were driven by water, seven by steam, one by wind, and all the rest by the more expensive power of horses.

East Cumberland is equally well supplied with this kind of machinery, and the number is annually increasing, with an evident tendency to apply more water-power. The time appears to be approaching when horses will be kept to perform such work only as other kinds of power cannot be so effectively or cheaply adapted to.

Drills for sowing grain are slowly creeping into use: some private property, others kept by subscription, and a few for hire. More of these would be adopted if they could be furnished at a lower price, but they are much too costly for any but the large farmer to purchase for home-work. The barrow turnip-drill came into use soon after the introduction of turnips as a field-crop. About the year 1795 the ancestor of the present Mr. Dixon, of Rucroft or Ruckcroft, in the parish of Ainstable, procured a barrow-drill for sowing his patch of turnips with; and so highly was it esteemed as a saving of labour by himself and his neighbours, that it was lent all round the country, and worked *day and night* during the season.

The greater part are horse-drills now, with saddle-rollers to smooth the surface of the ridges and guide the seed-pipes.

Drills for depositing bone-dust and other pulverised manures are partially in use, where the sizes of the farms warrant such an outlay; but simpler and less costly machines than those usually sold must be offered to the public before the small farmer can profitably dispense with broadcast sowing.‡ Clover and grass-seed drills are so much appreciated for ease of adjustment and regularity of distribution that few farms are without either hand or horse drills for that purpose.

Grubbers and scarifiers are of various kinds and sizes, but

* Laing, in his 'Journal of a Residence in Norway in 1834–5–6,' says the thrashing machine "is diffused so much more universally than in Scotland, that our right to the invention appears very doubtful. In the parish of Overhalden alone, there are sixty thrashing mills. It is certainly not probable that a Scotch invention should find its way to Norway, and be much more generally diffused in its most remote districts than in any part of the country which claims the invention." —p. 168.

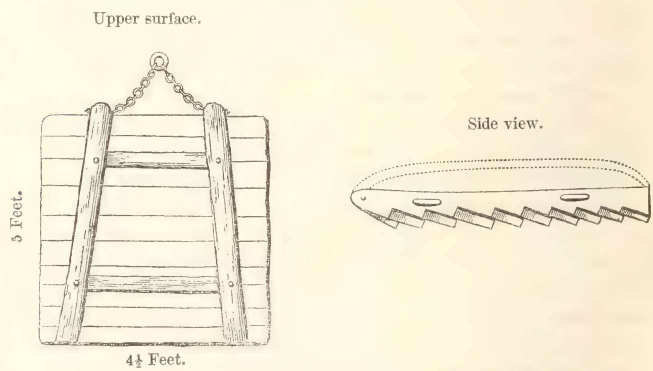
† *Vide* Dickinson's Essay.

‡ Messrs. Garrett of Saxmundham sell a drill for this purpose, reduced to the very low price of 12*l.*

Finlayson's principle governs most of them. Some are calculated for two horses, others for three and upwards to six, and are found to spare a ploughing or two in working fallows.

Crosskill's clod-crushers are in a few hands on large farms of clay or heavy soils, and are most effective implements when the land is neither too wet nor too dry, but the high cost prevents their more general adoption.

Cumberland claims as her own the improved "clod-crusher." The original of this was the Belgian "traineau," altered in shape, and improved from the flat to the ribbed bottom; the principle of its action is similar to that of the rasp, and it does not consolidate the ground like the roller. Crosskill's being the implement of the great farmer, "this, from its simplicity of construction and trifling cost, its ready adaptation to the draught of two or more horses, and, above all, its effective operation in filing down the hard clay lumps on which the common harrows make no impression," but merely tumble about like so many stones, "and which rollers only drive into the soil without breaking,"* is most essentially the poor man's implement. The size best adapted for working on level land with two horses is 5 feet long by 4½ broad. For hilly ground 6 or 8 inches smaller in both dimensions is more manageable, as it is apt to slide when worked sideways along the hill.



The dotted line on the side view above represents a wooden appendage for transforming the crusher into a sledge, when turned bottom upwards. It may thus be dragged from field to field without the trouble of carting, and without injury to itself; the machine is constructed of any kind of rough timber at hand, and entirely free from finer workmanship than the axe and saw, in the hands of a good labouring man, can supply. The cost

* Dickinson's 'Essay on the Farming of West Cumberland.' This clod-crushes is now in operation in Surrey, Middlesex, Hertfordshire, and various counties northward, to the Carse of Gowrie.

does not exceed 20*s*. or 21*s*. for the wood-work, and no exactness of dimensions need be observed. It has been suggested that a row or two of teeth in the hinder plank might be found useful in lighter soils; but, in weedy ground, the roots would collect before the teeth, and, by raising the ribbed surface, would throw the implement out of work.

The skim-plough is hardly known here except by description.

The waggon and two-horse cart are alike unknown in the agriculture of the county, and the single-horse cart hardly dates two centuries back. Even the clumsy cart* mounted on solid wheels was not in general use till the middle of the last century: before that period only yeomen and the larger occupiers could boast of carts; the produce of the farms, hay, corn, and peats, being brought in on railed sledges, and the more portable articles on packhorses.† Coal and lime were conveyed by the last method across the miry moors and commons, where tracks, instead of roads, existed, till near the end of the eighteenth century;‡ and many persons now living remember the very common use of the packhorse, both as the general carrier from town to town, and as the vehicle of transit for grain to the mill or market, and for manure, &c., on the farm.

The father of the present Mr. John Dodgson, of Roanstrees, in Bewcastle, was the first§ to have a spoke-wheel cart made in that vicinity, and the neighbours said "it wad aye be turnin'." When the roads began to be improved,‖ the utter unsuitableness of the clog-wheel and tumble-car was readily admitted, and its use, compared with the modern cart, soon acknowledged to be a waste of time. So convinced were all parties of the superiority of the spoke-wheel cart and its improved form and construction, that a very few years at the end of the last and beginning of the present century effected an entire revolution in the carrying department of the farm, and substituted the present light and easy-drawn vehicle as the confirmed and approved cart of the country for general purposes.

A few years ago the late Mr. Studholme, of Morton House, and two or three others, agreed that each should purchase a cart of the best construction he could find, and have the whole compared at Carlisle. The one bought by Mr. Studholme was

* Called a "tumble car" in the east of Cumberland, and a "clog-wheel car" in the west. Both appellations are very expressive.

† Hay was made into trusses with ropes, or packed into large sheets, and carried on horseback, in the west; some so late as 1824.

‡ A string of seven or eight pack-ponies might be seen laden with coals in the streets of Whitehaven so late as 1830, conducted by one woman of nearly eighty years of age. These were too near the era of railways to be longer encouraged, and are the last of the class remembered by the writer.

§ About 1785.

‖ Many of the ancient cart-roads were laid with broad flag-stones through the soft places.

most approved, and several of the kind have been made in that vicinity, and found to answer well; it is of the pitch-up kind, and has less mortising-work in the body of the cart than the common kind, the sides being of strong plank, and flush with the outside of the shafts; it is therefore less liable to imbibe moisture in those parts so especially liable to rot; the axle-tree ends are smaller, and occasion less friction in draught, but the weight of the whole,* as hitherto constructed, renders it only applicable to the level parts of the country; the drawing-chains are permanently attached to the shafts near the breech-crooks, and have to be hooked to the hames on yoking, giving a superior adjustment to the line of draught. The cost of this cart, with hay-shelvings, is 11 guineas; that of the usual cart from 8*l.* upwards; and the tumble-car was charged about 5*l.*

There can be no question as to the superiority of the single-horse cart over every other for the farm-work of the uneven surface of this county, and especially in the mountain valleys, where a portion of the arable land of almost every farm is on the steep hill-side, and there the waggon or two-horse cart would be cumbersome and inexpeditious, as well as in constant danger of upsetting.

In anticipation of the American machines produced at the Great Exhibition of 1851, an ingenious Cumberland farmer, Mr. Mann, of Raby Cote, in Holme-Cultram, invented a reaping-machine in the year 1832. This implement performed the cutting work with considerable regularity and despatch, but delivered the corn in a confused state in the swathe, and from some cause was never entirely perfected. It was thus described:— "The cutter is a disc of a regular polygon of twelve sides, and the gatherer a revolving drum with rakes, from the teeth of which a comb strips the straw, which then drops at one point of the machine in a continuous swathe. It requires horse-power, and a man to guide."

Haymaking machines are but thin in the county, and this may be imputed more to the cost than to any prejudice against them. Many farmers are more inclined than able to keep pace with the times by purchasing a new set of implements every now and then, with the improvements which every successive year is adding to them.

Great as is the support given to the numerous agricultural machine-makers, many a worthy and well-intentioned small farmer is obliged to suppress his inclination to buy, because of the inordinate amount of capital he must invest to give him the facilities his wealthier neighbour enjoys; and he who ventures on the inventions and improvements continually coming out,

* About $7\frac{1}{2}$ cwt. The common cart weighs a little over 6 cwt.

soon finds his store of discarded implements a serious item of dormant capital, and a consequent drawback on the profits. The small farmer is thus disadvantaged by being compelled to work his farm with a lesser variety of implements of an inferior class; and, in addition, has usually to meet the greater competition for his small holding by the promise of a higher rent in proportion than the larger tenant pays.

Without enumerating the smaller implements used on the farms, it may be sufficient to state that the farmers appear to be as deeply imbued with the onward spirit of the times as those of any county can be; and very many miss no opportunity of visiting the neighbouring agricultural exhibitions, and particularly the Royal Agricultural Society's show, when it is held in any of the northern counties. At those places they observe and compare, and, such as can afford, purchase whatever appears suitable for the operations of their several farms, and thus become possessed of implements equal and similar to the best in the kingdom.

Horse Trappings and Harness.—On inquiry into the ancient husbandry of the county, we find the accoutrements of the farm-horse to have been of a most primitive character. There is no record of the kind of harness used when the legislature found it necessary to pass "An Act agaynst plowinge by the taile." * And until the cessation of hostilities between England and France, when the border farmers acquired some security for reaping what they might sow, harness for other than the purposes of war and foray was not in demand.

Hemp was a material always in request for carrying out the arbitrary sentences of the Lords of the Marches and of the feudal barons of the county, and, in the absence of foreign commerce, was a necessary article of cultivation. Its uses in this department would naturally suggest its adaptation to the purposes of husbandry, where strength and flexibility were required. Some of the domestic arts, such as spinning and weaving, were necessarily carried on by the females during the disturbed periods, and continued till long after the men found leisure to devote their time to the cultivation of the ground. Thus trappings of hempen girthing came into use along with the "tummel-cars."

The head-gear of the horse was a hempen or straw halter; the "bragham" (neck collar, pronounced braffham) was a doubled sheepskin with the wool outside, or of plaited straw; the cart-saddle likewise of straw, or a sheepskin bag stuffed with straw—all produced and made up at home; and thus the horse was rigged out for the cart, and yoked at the shoulder by a pair of "widdys" (withes or willows), connecting with the shafts the heavy wooden hames, which were prevented from

* 10 and 11 Car. I., Sess. 4, c. 15, 1634.

slipping over the ends by pins through the shafts. This method of drawing was afterwards improved upon by substituting iron rings for the "withys." Thus accoutred, the cart-horse was not driven, but led by a man with the end of the halter in his hand, and the hand in the outside pocket of his long-lapped coat, and many a disastrous overturning was the natural consequence among the uneven tracks and hillocks of the miry and unformed ways.

The plough-gear was equally primitive with that of the cart, the traces being of rope drawn through a hole in the wooden hames, and secured there by a knot. The other ends were knotted to thick sticks, called swingle-trees, used rough from the axe; and the performance of the ploughman with his three or four horses, or horses and oxen mixed, his one or two drivers, and an assistant to hold down the beam in tough or stony leas, was on a par with the outfit.

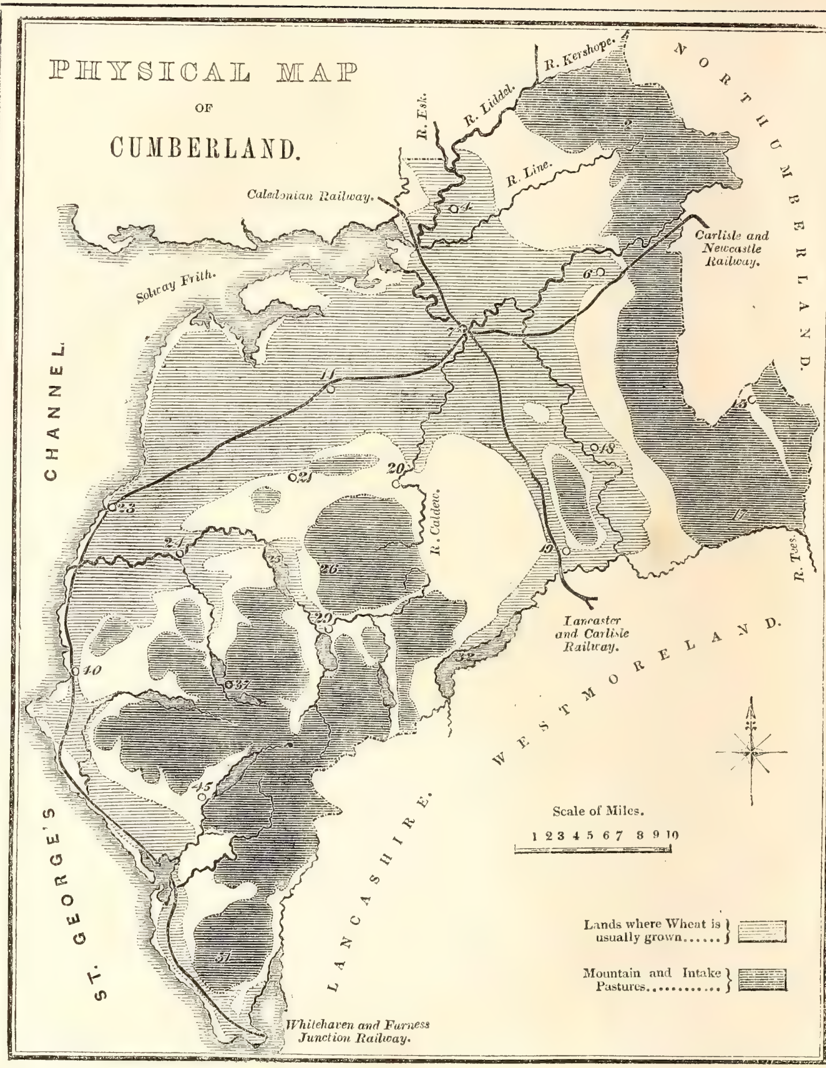
It was not till near the end of the last century that leather straps and buckles for cart-harness, and chains for plough-gear, came into use; nor before the first quarter of the present century elapsed that every vestige of the old style of harnessing had disappeared.

The present fashion of leather gearing is simple and light compared with that of some parts of England, but may still admit of some curtailing in the weight of the cart-horse bridles, and perhaps of the cart-saddles too. No time is lost in keeping brass buckles bright, or in polishing the hames or other iron parts, but too little time is spent in keeping the leathers of the harness clean and soft, for their preservation, as well as their appearance.

Old people, now living in the north of the county, talk of their fathers having ridden to fairs, &c., on the most primitive of all saddles—*a turf, cut thin, laid over the horse's back*, and tied on with a straw-syme (rope).

From the way of stabling the horses of those days (100 years ago) at fairs, viz. in old barns, or any unstalled building, untied and unfoddered, it was no unusual thing to find the straw-girth had been eaten away and the saddle trodden under foot. The writer remembers seeing stirrups of straw used with pads made of something like hempen cloth or very coarse linen.

(To be concluded in the next Part of the Journal.)



REFERENCES TO TOWNS, &c., IN THE PHYSICAL AND GEOLOGICAL MAPS OF CUMBERLAND.

(L. means Lakes; M., Mountains.)

1. Kershope Foot.
2. Bewcastle.
3. Kirkandrews on Esk.
4. Longtown.
5. Lanercost.
6. Brampton
7. Carlisle.
8. Bowness.
9. Kirkbride.
10. Abbey Holm.
11. Wigton.
12. Hawkesdale.
13. Castle Carrock.
14. Hollburn Pike, M.
15. Alston.
16. Rudderup Fell, M.
17. Cross Fell, M.
18. Kirkoswald.
19. Penrith.
20. Hesket Newmarket.
21. Ireby.
22. Allonby.
23. Maryport.
24. Cockermouth.
25. Bassenthwaite, L.
26. Skiddaw, M.
27. Caldbeck Fells, M.
28. Saddleback, M.
29. Keswick.
30. Derwentwater, L.
31. Patterdale.
32. Ulleswater, L.
33. Helvellyn, M.
34. Thirlmere, L.
35. Wytheburn.
36. Borrowdale.
37. Buttermere.
38. Blake Fell, M
39. Workington.
40. Whitehaven.
41. St. Bees Head.
42. Egremont.
43. Ennerdale.
44. Copeland Forest.
45. Wasdale.
46. Screes, M.
47. Scafell, M.
48. Eskdale.
49. Ravenglass.
50. Bootle.
51. Black Comb.

ARRANGEMENT OF THE STRATA.

(For references to the situation of Towns, &c., marked with figures, see Physical Map.)

- A — Granite and Syenite.
- B — Greenstone, or Metamorphic Rock.
- C — Slaty Rocks.
- D — Old Red Sandstone.
- E — Limestone, Carboniferous.
- F — Coal Fields.
- G — New Red Sandstone.
- H — Red Conglomerate.
- I — Magnesian Limestone.
- K — Gypsum.
- L — Whinstone Dyke.
- M — Millstone Grit.
- N — Lead.
- O — Hematite Iron Ore.

PART II.

The Live Stock of Cumberland.

Horses.—What may be termed the general farm breed of the northern part of the county, is the Clydesdale, which prevails from thence along the western side of Scotland as far as Ayrshire and Lanarkshire, through the whole of which country there are carried on constant interchanges of stallions and mares. This breed has been long and deservedly noted for its strength, docility, and endurance, as well as for its activity and honesty in drawing. It is however a circumstance rather to be regretted, that the high prices paid by the Scotch dealers for large heavy-boned horses for drays has created a partiality, on the part of many breeders, for those qualifications, in preference to the more valuable ones of activity and power of endurance, more frequently and easily associated with moderate size. In these larger specimens is too frequently observable a more sluggish temperament, with looser proportions; they are also in general larger consumers of food: nevertheless, when liberally fed from the first, they are sufficiently powerful to take the side of a plough at two years' old and after working two or three years for their keep, are readily sold at the spring markets of Carlisle, Wigton, and Dumfries, for from 30*l.* to 40*l.* each, if of good make and action. A year or two since, when so many railways were being made, the demand was so high that even 50*l.* were frequently given for good cart-horses. Considerable numbers are also annually bought up at high prices by the Northumberland dealers, for the supply of Newcastle and the coal districts.

The usual and most highly esteemed colours are grey, brown, and bay: these last are frequently spoilt in appearance by a large splash of white on the face and legs, which, particularly when dirty, looks unseemly, and might as well be remedied by a little attention in breeding. Some breeders are also, strange to say, partial to a large plain head, which, they say, shows "good Scotch breeding." A tolerably good feather of hair on the legs is preferred.

On approaching the higher grounds bordering on the eastern moors and mountains, the size diminishes, indicating more or less of a cross with the ponies or galloways which are the denizens of the latter localities. These are wonderfully hardy, and compactly made, active little animals; and are a good medium for restoring these qualities to the larger breeds when wanted. Considerable

numbers of them are bred on the moors, where they *fend** for themselves, winter and summer; and are found to yield as good a return as any other stock, when kept in moderate numbers on the ground. They are generally taken to the great Brough-hill fair in September, when the most amusing scenes may be witnessed in the attempts at haltering and exhibiting the unbroken colts to purchasers.

In this county there has always been bred a considerable number of horses of the lighter description, and at one time stallions of the Cleveland breed were much run on. These have of late years very much given way to thorough-breds, the produce between which and the Clydesdale mares, well selected, not unfrequently turn out valuable carriage horses. The broad, and, as the dealers say, "rather too useful" characteristics of the dam, are however apt to manifest themselves here and there unduly, to the prejudice of style and uniformity. A safer plan is to select a Cleveland mare, a cross between that and Clydesdale, or between the latter and blood, to put to the thorough-bred horse. Stallions of proper qualities are not easily to be met with—the present system of breeding too exclusively for speed having materially deteriorated the form of our modern thorough-breds for country use, which we now too frequently see weedy, low-shouldered, narrow-made animals, approximating in some degree to the shape of greyhounds. Of all the defects entire horses of this description are liable to, there is none so much to be guarded against as that of *roaring*—a source of the greatest amount of loss and vexation to the breeder; and it behoves the committees of agricultural societies to instruct the judges to pay the greatest possible attention to this particular, and to thoroughly examine the horses submitted to their inspection; and should this infirmity, or any other natural blemish, be detected, to reject them at once, even if otherwise unexceptionable.

A considerable number of fine horses are however annually drawn out of various districts of the county for the London and other markets. The principal fairs for these are Preston at Christmas, Durham in March, and Newcastle in October, where there is generally to be seen a large assortment of horses, and a fair competition of dealers, at least for the best animals, which have been of increased value since the extension of the railway system, and seem likely permanently to maintain it, as, from the almost extinction of coach travelling, the vent for the inferior animals is greatly diminished; and as large numbers of them are necessarily produced in the attempts at the better ones, it follows that the farmer must either have a higher price for the best, or be discouraged from cultivating this kind of stock.

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* Provide.

The eastern division is particularly indebted to R. Ferguson, Esq., of Harker Lodge, who has for many years spared no expense in the attempt to furnish it with the best blood stallions that could be procured. The Earl of Lonsdale has provided the western division with the Suffolk Punch for improving their breed, and several others have introduced many good horses into the county. Horses are bred on most of the farms of 80 acres or more, for the use of the farm or for sale; and, where of proper sorts, are profitable.

Cattle.—The researches of naturalists tend to show that every species of animal in the wild state preserves its own characteristic form and colours, and that it is only when its habits are interfered with by domestication, and by the caprice of man, in his attempts to adapt it to his uses, that it loses its original distinctive tints and markings, and acquires new ones: thus nearly all the accounts of the wild breed of cattle in the north of England represent them as having been white, or pale cream-colour approaching to white, with black-tipped ears. Some mention black muzzles, and others speak of red ear-tips and muzzles, varying a little in different and distant localities. The wild breed in Chillingham Park, in the neighbouring county of Northumberland, have red ear-tips and black muzzles, their bodies being a pale cream-colour.* Sandford, in his manuscript description of Cumberland, dated 1675, says, around Naworth formerly were "pleasant woods and gardens; ground full of fallow dear, feeding on all somer tyme; braue venison pasties, and great store of reed dear on the mountains; and white wild cattel, with blak ears only, on the moores; and blak heath-cockes and brone more-cockes, and their pootes," &c.

The Caledonian Forest† wild cattle are a dun, or rather flea-bitten, white, and have black muzzles and ear-tips, with spotted legs. The Drumlanrig wild breed, now extinct,‡ had the like markings. The Gisburne Park breed of wild cattle are pure white, with brown or red ears and noses. The two last herds were hornless; the others have horns of medium length.

It is not now known if Cumberland anciently possessed a native breed of long-horns having white backs, but on account of the variety of colours and markings they exhibited, the long-horns appear to have been the result of crossing among more than one of the wild breeds; and it must be evident that wild breeds of

* There has been a conjecture that the white wild cattle came originally from Italy, where it is said they were at one time used for sacrifice to the celestial heathen gods—the black or dark-coloured to the infernals.

† The cattle of the Caledonian Forest are said not to degenerate, though all of the same breed for hundreds of years.

‡ Two cows and a bull were living in 1821, but the bull and one of the cows died from the effects of removal in that year.

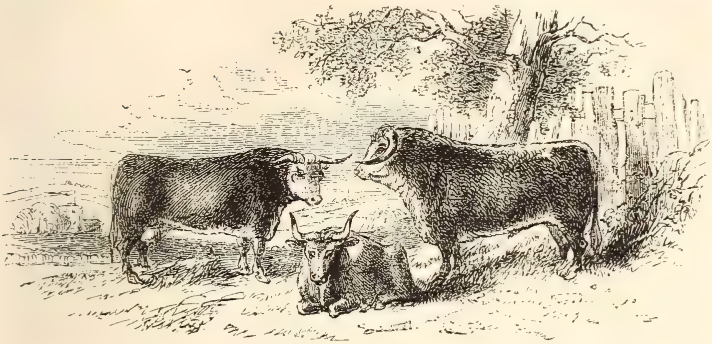
the darker colours existed in former ages, such as blacks, browns, reds, duns, &c., as these are still found in a domesticated state.

Within living memory, the cattle in Bewcastle, Stapleton, Kirkandrews, Alston, and the neighbouring parishes, were of the long-horned breed, and chiefly of dark colours, such as blacks, browns, and dark reds (the last colour most prevalent), with the distinctive white backs; and these were reputed to have resulted from the intermixture of the Scotch and English breeds, occasioned by the forays and reprisals of border warfare; and accordingly, advancing from Scotland (the present great district of black cattle) in a south-westerly direction, the colours appear gradually to have been of lighter shades, till at the other extreme of the county (Whicham, Millom, &c.) the whitest of the long-horns have been prevalent. Few of the long-horns have been without more or less of the darker colours, and the rich-looking, dark, velvety, chocolate-coloured sides have been the cherished colour; but all, or nearly all, have exhibited the characteristic strip of white along the back; and these may be considered as the peculiar breed of this county, so long as the county had a breed of its own.

In all recent times there have been varieties in certain districts, kept tolerably pure for a length of time; and these have brought themselves into notice by peculiar qualities or colours. For instance, the Lyzick breed, which emanated from the Hall of that name, at the western foot of Skiddaw: they were truly a beautiful race, with fine spreading horns, and nearly pure white, except the ears and muzzle, which were dark brown, and a few small dark spots on the sides and legs. When seen in herds, their lively figure and lofty carriage rendered them probably as ornamental a kind of cattle as England produced at the time; but their indifferent milking qualities hastened their extinction.

The Lamplugh cattle, usually termed "Lamplugh hokeys," were another race peculiar to the neighbourhood from whence their name was derived. About the commencement of the present century they were especial favourites, from their hardiness, quietness, and excellent grazing qualities; and they were also average milkers. This breed stood low on the leg, and though exhibiting many features which are now objected to—such as thick joints and heavy hides,* with abundance of dewlap and "neck leather," some with heavy horns, and mostly of clumsy appearance—were always, when of pure blood, quiet, reasonably quick feeders, and first-rate butchers' cattle. Their colours were dark red or brown, and some black. All had white faces and legs, and

* Many of the cows' hides weighed from 7 to 8 or even 9 stones at the slaughter, and were greatly prized for making leather of a strength and firmness such as cannot now be found or made.



almost invariably the distinctive mark of the long-horns, viz. the white stripe along the back. The eyes were commonly margined with a narrow band of the predominant colour, as if bound about with coloured tape. Their horns were long, and stood in various directions; but the group annexed will convey the best idea of this now extinct race. Towards the end of their reign, they got deteriorated with other blood; and, by thoughtless and injudicious crossing, became perhaps the worst kind of cattle in the county. Their uniform white faces gave them a rather singular and pretty appearance as to colour, strikingly resembling the Herefords, whose descendants they might have been; but by whom introduced, at what period, or how originally selected or crossed, there is no record. A very few of the crosses from this breed may yet be recognised, but the pure breed has been lost among the all-pervading short-horns.

Another variety had the colours, size, and qualities of the long-horned breed; but were either entirely destitute of horns, or had merely rudimentary processes of loose horns of 2 or 3 inches long, turned downwards, and partly imbedded amongst the hair.

At the end of the last century, these varieties of the long-horns constituted the entire bovine breeding stock of the county; and if others were introduced, as they annually were, it was for the purpose of grazing only.

There is scarcely a stock of pure long-horns existing in the county at this date. Mr. Douglas, of Crofts, near Whitehaven, had a fine herd of over sixty till 1848; but they have been crossed with the short-horn since. Mr. Bowman, of Mireside, in Ennerdale, has still managed to keep a part of his stock pure, and has recently found good demand for his bull calves at nearly 10*l.* each.*

* Mr. Isaac Fletcher of Riggs, in Embleton, has a very fine dairy stock of about 20 long-horn milk cows, from which he annually rears a number of pure bred heifers and bulls.

At the commencement of this century, Galloway cattle began to obtain a footing along the border joining Scotland, where the long-horned breed had been kept tolerably pure, notwithstanding the unsettled state of former times. Some few might have existed in the northern confines of this county for a long time before, these having been obtained through the predatory inroads of that period; but it became an established rule on both sides of the border, whenever it could be privately done without the knowledge of the lords of the marches, to consign forthwith the carcase of every edible animal taken in foray to the pickle-tub or the smoking-chimney, if it bore any marks by which it could be identified; and thus the cattle of neither country were or could be introduced into the other till a friendly and peaceable intercourse prevailed. Then, some enterprising occupiers in the Abbey Holme were at the pains to select and introduce a few well-bred Galloway cattle into their district, for the express purpose of rearing a distinct breed, approved for hardiness and milking qualities.

From the almost certainty of the produce of a pure-bred Galloway bull being entirely black and without horns, from whatever coloured dam, the kind soon began to predominate there and in the neighbouring parishes, and finally to nearly displace the longhorns. About the year 1820, Sir James Graham turned his attention to the improvement of the Netherby estate; and shortly after, for the greater encouragement of his tenants (along with distributing about 60*l.* in premiums for superior management, &c., annually till 1840), every year gave three or four bull calves and stirks of the Galloway breed in prizes from his own herd, which had been carefully selected from the best stocks in Galloway.

This was a sure method of extending and improving the breed in the district, and was most successful on the inferior farms, the short-horns being generally preferred on the good land. The large parish of Bewcastle, containing nearly 28,000 acres, is now in consequence almost entirely stocked with the Galloway breed; and much of the north-eastern quarter of the county also produces that breed in tolerable purity. There can be no doubt of those cattle suiting the high parts of that district better than the shorthorns or any other breed, and the just predilection of the occupants in their favour will ensure their permanency.

Careful and judicious breeders* of Galloway bulls are found over the county, from the neighbourhood of Holme Cultram, along the northern and eastern border, to Alston; and, judging from the prices at which most of them send out their select young

* Breeders of this stock would do well to pay more attention in their selections to the evenness of loin and fineness of rump of the short-horn model.

bulls, there is no present appearance of the breed losing ground in that quarter.

Some of our most enthusiastic breeders of Galloway cattle dispute the superiority of the short-horns for early maturity; and one who is nearly, if not quite, the oldest* breeder of them, says, "*More depends upon the rearing of stock than on the kinds of stock.* I have at present some two-year old Galloway heifers that are fit for the butcher; and they have not had any extra food, such as oil-cake or corn, and last winter had turnips once a-day only." The race of superiority is now fairly started between the rival breeds, and future years must declare the winner. Some of the best Galloway bulls have been sold as high as 30*l.*, and the yearlings and two-year olds of high blood usually fetch from 15*l.* to 20*l.* each.

The short-horn is however the predominant breed of the county, and of their present general utility on turnip-growing farms there can be no doubt: they are easy to rear from the first hour of their birth, healthy through life, profitable at the slaughter, and so far the evidence is much in their favour as to early maturity. What effect the almost general system of forcing, with a view to early maturity, may have on the constitution of the race, it may not be difficult to prognosticate. The high keeping of most of the pedigreed stocks, now pretty numerous in the county, must eventually tell with a detrimental effect on their constitutions.

Short-horns have been bred in Cumberland about forty years. Their introduction was regarded with doubt and distrust, and their progress was accordingly slow for many years; but the last twenty-five years have spread them over the county, and placed them or their kindred on every farm not devoted to the Galloway or some other special breed.

Mr. Howard has a beautiful and well-selected breeding-herd of 200 gold and silver dun Argyleshire cattle in the park at Greystoke Castle. They are of the purest blood and quality, and many of them attain the weight of 50 stones when fat. At a distance they resemble a fine herd of deer, and several are as wild too; but they form a noble adjunct to the grounds, and such as no other park in the kingdom can boast.

It would be reckoned invidious to attempt to enumerate the breeders of short-horns here, there being so many who have attained celebrity and been successful; but it may be allowable to state that the late Mr. Curwen, of Workington Hall, and Sir James Graham, of Netherby, stood most prominent as the early breeders; and, at a later period, the late Earl of Lonsdale, though his herd was kept beyond the boundary of the county, reared

* Mr. Rigg of Abbey House, 1851.

and disseminated a large number of the highest blood * in the kingdom over all Cumberland.

The prizes offered by the Agricultural Societies keep up the spirit of enterprise among the breeders; the proved utility of the stock seems to set all competition of other breeds at defiance, and they now appear, after the lapse of a very few years, to have become the staple stock of the country. It is pleasing to record the enthusiasm of the present breeders of short-horns, in procuring from time to time, by clubs and small joint-stock companies, or single-handed, the very best young bulls they can meet with among the first stocks in the kingdom, almost regardless of price, if the cross of blood, &c., promise success. The neighbourhood of Penrith stands pre-eminent for the number of high-bred stocks, but there are many of first-rate quality in various parts of the county.

It may be proper to put on record, that, with few exceptions, the friendly competition and its attendant honour are chiefly in the hands of tenant farmers or of the smaller yeomanry, and their zeal and success are alike creditable to them.

From time immemorial Cumberland has been a cattle-breeding county to a large extent, sending out great numbers, formerly of lean, but latterly of both fat and lean stock, every season. In addition to the home-breds considerable numbers are imported from Scotland, Ireland, and the Isle of Man, for grazing purposes. Not so many calves are now fed for the butcher as formerly. By far the greater part of them, of both sexes, are reared. The bullocks are sold off at one, two, and three years old. The best of the heifers are kept for dairy and breeding purposes, and the rest fed or sold with the barren cows to the graziers of other counties; and none are found to excel them in feeding qualities.

The produce of the dairy has always been an object of emulation among the farmers and their families; and, until the last few years, it is singular to note so little pains have been taken to combine and perpetuate that valuable union of feeding and milking qualities which is evidently so desirable if it can be attained. There are certainly more difficulties to contend with in forming and continuing such an union, than in perpetuating these excellent properties in a separate form; but it has been accomplished and kept up for several generations in the descendants of the stock of Mr. Ferguson,† of Harker Lodge, who purchased the high-bred originals, "Favourite," "Elvira," and

* To sustain high breeding, access must be had to a number of good bulls. Some may suit to cross one part of a herd with, and some another. Very few will suit to improve the varying defects of a whole stock.

† Mr. Ferguson is one of the oldest living short-horn breeders in the county.

"Kate," from Mr. Binns, of Lancaster, in 1819. These were of first-rate breeding, and high feeding qualities; and of their milking and butter-producing properties Mr. Ferguson has thus written:—"With regard to Kate, as to milk and butter, the quantity of each was so extraordinary that I should say it was quite incredible, had I not myself been an eye-witness of it. It was tested in two ways, wherein there could be no doubt. For many weeks she gave 13 quarts at one meal, each quart producing 2 ounces of butter; the quantity being so large, I had the milk kept by itself, and *at seven days' end we churned* TWENTY-SIX POUNDS OF BUTTER." Mr. Ferguson adds, that this cow, during the time, got nothing but grass from an ordinary pasture. The offspring of this remarkable family of cattle are yet among the herds of Mr. Fawcett, of Scaleby Castle, and others, both in this county and Westmoreland, and are still found to retain their valuable properties to a great degree, though of necessity crossed with other blood. The short-horn cow "Dairy," belonging to the late Mr. Calvert, of Sandysike, near Brampton, is another instance of extraordinary yield of milk and butter from an animal of capital feeding qualities, and of good points and breeding. This cow gave, on a pasture of middling quality, 28 quarts of milk per day, from her time of calving in spring till midsummer, and averaged 20 quarts per day for 20 weeks. In 32 weeks she produced 373 lbs. of butter, averaging $11\frac{5}{8}$ lbs. per week. The greatest weekly quantity given during that time was 17 lbs., and the least 7 lbs.*

Mr. Jackson, of Barngill House, when at Moresby Mill, was supplied by the writer with a cow (the only one kept at the mill) which, on grass and bran, regularly gave from 14 to 16 lbs. of butter weekly during several seasons, besides 2 quarts of new milk a day, used by the family. This cow was of the ordinary short-horn breed, and fed rapidly when not giving milk.

There can be no doubt of raising a breed uniting these very desirable qualities, *if due pains were taken in some large stock which could send out a number of young bulls annually;* the elements of success are not scarce; they only want concentrating by some man of resolution strong enough to reject a fine or favourite animal if defective in her milking qualities. The dairy books kept by some gentlemen farmers show the milking qualities of their herds with great accuracy; and the lactometers or graduated glass tubes give the relative quantities of cream produced as often as the trials may be instituted. These are safe

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* The produce was carefully kept separate and registered by the owner, whose Journal of it the writer has perused. The writer also purchased two of Dairy's descendants, which both possessed the remarkable qualities of their parent, but in a less degree as to butter.

guides, and if brought into general use on farms would unfold truths which many do not think of.

Feeding cattle for the shambles has been practised in Cumberland in the summer season for a long time, yet so rare an occurrence was it to find beef exhibited in the market during spring and summer, towards the end of the last century, that the butchers of Whitehaven even then thought it necessary to advertise* in the newspapers before they slaughtered a beast. It was seldom that heifers† or oxen were fed at that period; they were mostly sold to go out of the county to feed, and only cows were fed here. When winter feeding was resorted to, it was often with a view to get rid of some old or exhausted cow, which had been kept as long as useful or safe.

The usual keep for the feeding cow of that date was a cart-load or two of the best hay stored by itself, and the tops of the nicest corn-sheaves, if the teeth were good, but if not, the corn was crushed at the mill, or in the creeing-trough‡ at home. So late as that time it was usual for a butcher or a grazier to slaughter a number of cows§ at Martinmas, and supply customers with a quarter or (rarely) a side of beef, part of which was consigned to the chimney to dry, for summer use, and the rest to the brine-tub, as a winter store. This, with a side of bacon, a few dried mutton legs, and as many salmon as could be caught, formed a year's store of meat for the farm-house. More than one or two cows being fed on a farm in a winter season was then a rare occurrence; but after turnips were grown more plentifully, and their uses approved, winter feeding became more general. Mr. Mossop, of Rottington Hall, the late Mr. Fox, of St. Bees Abbey, and, after them, Mr. Benn, of Monkwray, were the first to winter feed any great numbers in the western division. Mr. Wright, of Oakbank, near Longtown, was the first in that neighbourhood, about the year 1823. Since then the practice has increased as the culture of turnips has extended, and many arable farms now feed annually their twenty or thirty, or more head of cattle, which are mostly sent off as they become ready, by steam-ship or rail, to the great markets of Liverpool, Newcastle, &c.

It is always the object of the Cumberland grazier and winter-feeder to make his cattle pay for the food they consume. He reckons it an unprofitable season if any part of his profit requires to be charged on the dung-heap; and on an average of years his

* The columns of "Ware's Advertiser" furnish several instances of this kind.

† There was thought to be something wrong, verging on the criminal, to feed heifers in some parts of the county before they had been tried at milking.

‡ This was a stone trough, with a round bottom, like the druggist's mortar; and the corn was crushed by hand, with a stone or a hard wooden pestle like the pavior's beater.

§ In Bewcastle the winter beeve was called the "mairt."

judgment in purchasing and his care in feeding, chiefly with the produce of his farm, enable him in ordinary times to square his accounts satisfactorily on that head. Swede turnips form the groundwork of his system, and these are given as liberally as the constitution of the animal is able to bear. Where hay is grown, that is given to the cattle to ruminate on; and where no hay is grown, or none can be spared, straw is resorted to. Corn-sheaves cut into chaff, with clover or other hay, boiled or steamed, are given largely on some farms; and oatmeal or crushed corn is often added as the cattle advance towards market fatness. Some purchase oil-cake, bean-meal, &c., but those articles are not in common use. In the present season (1851-2) the low price of wheat has induced several to give the flour of that grain to their fattening cattle, instead of other forcing food; and the cattle do well on it. Salt is commonly given, and many find their advantage in having the cattle regularly curried or brushed in the same way as horses are dressed.

The dairy cattle are fed in a similar way, with turnips and cooked food, hay and straw; with bran, grains, linseed, or sometimes meal in addition.

Young cattle are generally kept on straw or hay and turnips in winter, without anything else, except what scanty herbage they may pick up in the fields, where they are commonly put for a few hours every day. On the small farms among and near the mountains it is thought an extravagance to purchase any kind of cattle food, except rarely a little hay towards spring. On these farms there is usually more pasturage, and the whole herd of cattle are turned out during the day, by way of saving fodder; *but it too often happens they are kept starving at the gate for an hour or two every afternoon, till the regular time of tying up arrives.* Such people think they cheat the cattle out of a meal, and expect to profit by it, while in reality *they cheat themselves by starving their cattle and wasting manure*, not giving it a thought that the sheds and cowhouses are much more comfortable standing, without food, than the miry gateway, and that the manure would be saved too.

Thirty or forty years ago it was the practice to tie up only the cows and oldest set of heifers, the rest of the young ones being wintered in open sheds, or some in the fields. Now it is found that they can be most equally dealt with when all are tied; consequently there are few farms now where any but the calves are suffered to battle each other in loose sheds, where one or two master-cattle beat the rest back, and become the cause of great inequality in the condition of the lot.

Box-feeding is in partial use on a few farms, and is approved in everything but the expense of buildings.

On the higher farms, where purchased food is not much resorted to, the calves are reared in the spring months, when milk is most plentiful, with one or two in winter, which are gradually accustomed to oatmeal-gruel, hay-tea, or boiled chaff and turnips, as the milk is withdrawn. And it is usual for the winter-bred calves to make the best cattle.

On the larger arable farms, where cattle are also bred, the calves are reared at all seasons, with a preference to those dropped in winter or early spring. Among these each feeds his calves according to his ideas of economy and utility,* with home-grown or purchased food, linseed or oilcake being commonly preferred; and some ingenuity is often exerted with a view to spare milk from the calves for the use of the household, or for sale, if near towns. When the grass declines in autumn, the young calves are put upon the clovers, or on grass seeds after harvest. Some are kept out on the seeds and the best of the pastures all winter, with a small allowance of hay or other food. And there are some farms where the risk of black quarter, otherwise inflammatory fever, is much less frequent among calves in the field than among those in the house.

Agistment of Cattle is largely practised over the whole county. The extensive parks of Gowbarrow and Glencoin, adjoining Ullswater, accommodate a large quantity. Greystoke Park annually carries from 800 to 1000 head of agisted cattle, in addition to the beautiful dun highland herd. Spadeadam, Bewcastle, Nichol-forest, and many other parishes along the mountain sides, have large agisting pastures. On the princely holms of Esk, where the feuds of old were so frequently contested, and where no cattle could then be trusted, now 300 graze in peace. Burgh Marsh is also an excellent and extensive pasture of this kind, and so is the park at Muncaster Castle. There are very many other pastures of lesser extent, where cattle are agisted at prices varying from 3 guineas at the Netherby holms, to 2 shillings on the steads of Borrowdale. Many thousands are annually sent out in this way, and remain from May till about the 1st or 10th of October.

The common way of rating the prices of agistment is by the standard of a three years old heifer, which is reckoned a full stint; and all the other prices are regulated by it.

	£	*s.*	*d.*
If the full stint is worth	2	0	0
The two-years old is	1	10	0
The yearling	1	0	0
A three-years old horse	4	0	0
A two-years old	3	0	0
A yearling	2	0	0

* The least troublesome and most economical way of rearing late spring calves is to put them to nurse with a cow giving about five quarts per day. This has long been practised by the author, who occasionally rears lambs in the same way—one cow rearing two or three at a time.

The aged horse ranks equal with the three-year-old, and the aged cow with the three-year-old heifer. There may be trifling variations, but the above is the usual rate of proportion of charging for the summer grass.

If any young cattle are grazed at home it is usual to keep the best and to send out the worst to grass, so that there commonly assembles on the agistment ground a lean and ragged crew.

Pastures which graze part of the owner's cattle along with the rest are usually well regulated as to number and attendance, and the stock go off in good condition. Such as are entirely depastured with agisted goods are too often over-stocked, so long as people are simple enough to send to them.

There are no diseases among cattle peculiar to the county. Some localities, indeed, are more liable than others to certain complaints, but even these exceptions seem gradually wearing out.

On the writer's commencing farming he was cautioned against buying cattle from Threlkeld or the Abbey Holme, on account of their reputed liability to common red-water upon removing to other pastures. At that time the Threlkeld people with their cattle were hustled to a side at the fairs at Keswick, and were not allowed to pass off their cattle of ill repute for the breed of other dales. The old charge against both of these districts is now entirely removed, and their cattle mix with others on strange pastures, and are not more susceptible of disease than the rest.

Acute red-water* is rare in its visitations, but its attacks are very fatal, and apparently incurable. On hundreds of farms it has never been known, and but a very small number have ever felt its effects.

The county has had its proportion of murrain and pleuro-pneumonia during their seasons of prevalence, but they are now seldom heard of, and if they occur it is usually in a milder form.

The cattle in some mountain vales are liable to an affection of the stomach, provincially called "crobbek" or "crovek," exhibited in a fondness for chewing bones, leather, and clothes. If this disease is suffered to go on unchecked, the bones of the legs make a rattling noise in walking, the joints swell, the animal loses its appetite, and spends its time in hunting round the field for bones, &c., instead of depasturing and ruminating, and eventually dies. A change to rich keeping for a few weeks in the earlier stages is the ordinary and effectual cure. It is remarkable that limed land is not liable to this disease.

The services of a skilful native cattle-dentist † have been much in request of late years, and appear to be more appreciated as the

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* In 1848 the writer lost eight in one fortnight of July, and at the same season in 1849 seven more, being all that were attacked in both years. These were the only visitations remembered on that farm.

† Henry Douglas of Cockermouth.

benefits become more widely known. Whether the discovery originated with him or not, the merit of its extensive application is entirely due to him, and his theory appears consistent, viz., that young cattle shed, or ought to shed, their back or grinding teeth in pairs at stated periods, or about the periods of their casting the front teeth; and that, as the decay or absorption of the old tooth commences at the point of the fang or prong, and proceeds towards the grinding surface, it frequently happens that the old shell or surface of the tooth is held too long in its place by the adhesion of the gum and the wedging of the adjoining teeth. By this means the animal is disabled from properly masticating and ruminating its food, until its condition is impaired; and, if neglected, the health and constitution suffer, and in some cases death is the result.

The annual or more frequent periodical examination and removal of the dead shells and uneven teeth by the dentist have been very efficacious in relieving hundreds of young cattle, some of which in former times would, by the consequences of neglecting this simple precaution, have been condemned as unsound, and others have been kept in an unthrifty state till nature effected their relief.

Cattle-Dealing and Fairs.

The county of Cumberland possessing many good sea-ports conveniently situated for importing cattle from the north and north-east of Ireland, and being also the great thoroughfare from the principal breeding districts of Scotland, might reasonably be expected to be supplied with a corresponding number of occasional cattle-dealers.

Several occupiers of high-lying grass farms are of necessity dealers in cattle, to a greater or less degree; for the farms being calculated for keeping a much greater stock in summer than in winter, the occupiers must be buyers in the spring and sellers in the autumn; and this induces a habit of trading when opportunity offers. In the northern half of the county they are tolerably numerous, and of active habits, some of them undergoing much hard labour in their vocation, far exceeding their usual remuneration. But the business is so exciting and the hope of profit so tempting, that no amount of exertion, or exposure to storms, or fear of loss, will deter a man, who has thoroughly embarked in the speculation, from risking both life and property in the very hazardous pursuit he has chosen. Many a long and weary drive has the cattle-dealer of the north of Cumberland from Dumbarton, Falkirk, Stirling, and others of the leading Scotch trysts, over mountain and muir, in sunshine or storm, with his slow drove of wearied black cattle, in which he, perhaps, has embarked the whole or

most of his capital—or, it may be, his credit. But, worst of all is his drive from the tryst called (from the lateness of the season when it is held) the "Snowy Doune." The small cattle shown there from the north will seldom afford the cost of transit by rail, and they must be up to Carlisle Sands by a certain day in December, or the market may be missed. They are often crippled by long driving, and lame from the hoofs being worn through. The weather is commonly very stormy at that season, in which case the men's clothes are wet through day and night; or hard frost, when the cold is almost unbearable. If provender can be had at a reasonable rate, the cattle take least harm when there is snow upon the ground, it being soft for their lame feet to walk upon.

Shoeing the lame cattle is sometimes resorted to, and, when necessary, is often more costly than would appear from the simple nature of the operation: for, to save the trouble and cost, the cattle are often driven to the very last stage of lameness, and during that time are rapidly losing condition. Then comes the delay of the whole drove while the invalids are being shod—an operation which the fidgety little creatures refuse most obstinately. This occurring daily, occasions much loss of time, and consequent hurrying and overdriving to reach the market; and frequently the drove is either sold at a loss, through their jaded condition, or cannot be sold at all.

Contingencies such as these may be thought common to the trade, and so they may be at all other seasons; but the latter, or "Snowy Doune," seems to be almost the Cumberland drover's own; the dealers from the more southern counties having invariably supplied their customers sooner in the season, and the Scotch dealers seldom coming forward to Carlisle at that inclement season, the native dealer almost thinks himself in honour bound to support the home show, which the strangers do not provide for.

Very many thousands of cattle change hands on the sands at Carlisle annually, and indeed a few thousands weekly at some seasons. The principal show on the great fair days consists of highland cattle; next in number are Irish, then Galloway, Fife, and Aberdeenshire, Ayrshire, short-horn, and county-bred mongrels.

The great shows at Carlisle, which are held to follow the Scotch and Highland trysts, are well attended by both buyers and sellers of cattle, and it is there chiefly that the jobber first acquires a passion for dealing, by a small profit, from his early attempts in trade. With the great facilities for trading, and the frequent opportunities afforded at Carlisle, there need be no wonder that the small farmers of the neighbourhood are tempted to make or mar their fortunes by a turn at cattle-dealing.

But, independently of their individual interests, for which themselves must care, it would seem that dealers in cattle are as useful in the economy of agriculture as merchants in the commercial world, acting a similar part in collecting from abundance and dispersing amongst scarcity. A great proportion of the cattle and sheep in the county passes through one or more hands between the breeder and feeder, and between the breeder and consumer one or two more. Many farmers would be at a loss in purchasing their supplies of cattle, and disposing of their surplus stock, without the aid of the jobbers; and some, not having confidence in their marketing qualifications, rely solely on them in the transfer of their live stock: thus saving much time which would be spent in markets and fairs, and, where mutual confidence exists, money also. Some combine the business of farming with that of dealing; and most of the North Cumberland farmers, from their adjacency to the great driving-roads, have a smattering of trade in either cattle, sheep, or horses.

Of late years, the sands at Carlisle having been more largely supplied with sheep on the days of the cattle-shows, it has been found desirable to remove that part of the show, to make more accommodation for cattle, which are also on the increase. By the judicious arrangements of Mr. Rome, whilst Mayor of Carlisle in 1850, an adjoining field belonging to the Corporation has been set apart for the show of sheep, and is found to be a great convenience, from its proximity to the cattle-show, without the one interrupting or interfering with the other.

Weekly shows of cattle and sheep are held on the market-days at several of the market-towns, and fairs at sundry places.

Sheep.—The sheep-farming of the county, and the breeds of sheep, are of the most variable description. What the original breed * was, or what the breed of a few hundred years back, there is no certainty. One hundred years ago the sheep were nearly all of the grey-faced or black-faced moor and mountain breed. At that period, when nearly half the low-lying district and the whole of the hills and mountains were open common, almost every farm had a frontage to some common or other, or access to one by an "out-gang," or narrow strip of open land leading from the village to the common. The enclosure of all the low commons, and of portions of the higher, and the consequent cultivation of all the available parts, caused the sheep to be sold off in thousands, till, about the year 1820, few except those on the mountains remained. Since that period, drainage and turnip culture have been widely extended, and the system of feeding sheep on turnips has been approved and practised to such an extent as to cause the numbers of sheep now kept to be little short of what

* Culley says the dunfaced. This breed is now extinct.

the commons maintained, and the weight of mutton and wool to be considerably increased, and the quality of the latter very much improved by the introduction of superior breeds and crosses.

The improved Leicester sheep are now bred with great care and attention, and great prices * given for rams on many farms in various parts of the county; and, though possessed of good qualities as a breed, the mutton of the Leicester ewe is at this time (February, 1852) worth less money per pound than that of any other kind of sheep. There are small flocks of South Downs in a few hands; these are kept chiefly to rear tups from, for crossing the mountain ewes with, when those are bought by the low-country farmers for rearing fat lambs. The issue of this cross is preferred before all others for the shambles, and is very hardy and of excellent fattening qualities. Cheviot sheep are bred on several farms of the higher district between the river Irthing and the Kershope. A few years ago the late Mr. Salkeld tried the Cheviots on the higher regions of Crossfell,† above his farm of Ranbeck, in the parish of Kirkland, but the experiment failed.

Trials on a small scale have been made with the Cheviots on the mountains in different parts of the county, but none have succeeded. Very probably they found the pasture too closely occupied with a hardier and more "fendy" (active) race.

A great majority of the sheep fed on the arable farms are of the Cheviot breed, or of the Leicester and Cheviot cross; and a part are the useful, but clumsy-looking, mule breed between the Leicester tup and the black-faced highland ewe. Most of these are reared in Scotland, and brought here at different ages (mostly in lamb) by dealers, who expose them for sale in the different fairs and markets. Some of the larger feeders go to make their own selections, and spare the dealers' profit. Many thousands are annually fed beyond the wants of consumption within the county, and the surplus taken by the owners or by dealers to Newcastle, Liverpool, Manchester, &c.

The black-faced mountain sheep, bred from and resembling the Highland stock, occupies nearly the whole of the Crossfell and Blackfell range (as the western front of the mountains north

* 15*l.* to 27*l.* in 1851.

† The herbage there (on the limestone) is sweet, the aspect southerly, and the whole apparently favourable for establishing a better breed than the common mountain sheep. A shepherd attended the flock constantly, and pains were taken to heaf them on the most likely part of the mountain, but all in vain. Every morning they were found at the fell-gate; and if the shepherd quitted his charge at any time during the day, they immediately left their pasture and followed him down to the walls. So utter a dislike had the flock to the fell, or to the sheep they found there, that after a long and patient trial, it was found hopeless to contend longer, and the attempt was given up as conclusive against their being established there.

of Crossfell is called), and is intermixed over Spadeadam Waste, Christenbury Crags, and all the sheep lands adjoining the counties of Durham, Northumberland, and Roxburgh, where they contend with the numerous ponies for pasturage. This breed is totally excluded from all the other mountains of the county.

An agricultural exhibition is held annually at Alston in October, where the black-faced sheep may be seen in full perfection.

The Herdwick breed possesses more of the characters of an original race than any other in the county. It stands lowest in the scale of excellence, and shows no marks of kindred with any other race. It is stated to have sprung from a few which escaped from a Spanish ship wrecked on the coast, and these having established themselves on the fells, were found to thrive and enjoy the locality; and since that, on increasing, have been farmed out in *herds*, and thence acquired their name. They occupy, to the exclusion of all others, the range of mountains from Wythop to Black Comb. The majority are without horns, and their legs and faces are grey or mottled. Where great care is exercised in selecting and breeding, the nose is of a lighter grey, and is then termed "raggy" or "rimy," from its resemblance to hoar-frost. Except the lambs (which are dispersed over the arable farms during the first winter, at about 3*s.* 6*d.* per head, for keep till Lady Day), they are kept on the mountains at nearly all seasons. The wethers are sold for feeding at four and five years old, and weigh from 12 to 14 lbs. per quarter—the ewes from 8 to 10 lbs., and the mutton is excellent. Formerly, many of this breed had large manes and beards, of very coarse grey hair; the fleeces were also much mixed with *greys* and *kemps*.* These defects are now removed, without injury to the storm-resisting qualities of the fleece.† The weight of fleece varies from 2½ to 3½ lbs. This breed is remarkable for attachment to the place where they are suckled, and this constitutes a part of their value in the eyes of the proprietors. In consequence of this fondness for their heaf or place of breeding they require less of the shepherd's care; and their heaf may be gradually curtailed or extended on any particular side without the trouble and expense of constant herding. No hay is given to the Herdwick sheep, except on extreme occasions.

The West Cumberland Fell Dales Association holds an annual show, alternately at Loweswater, Ennerdale Bridge, and Netherwasdale, at which about thirty prizes are given for the improve-

* Black or grey wool and stiff hairs.

† After heavy rains and strong winds in winter and spring, the wool of the fleece is turned to almost black, as if drenched with soot and water. This discolouring of the wool is an indication of the sheep having sustained a sudden and severe check in their thriving. As the weather improves, and the sheep begin to thrive, the blackness goes off, and the fleece resumes its natural colour.

ment of the Herdwick sheep solely, and are competed for generally by about a hundred exhibitors, whose flocks are limited to only a small extent of country.

There is another breed resembling the Herdwicks, but stronger in bone and heavier in carcase, which the owners claim to be a superior and distinct breed from the "little Herdwicks," as they derisively call them. A person unaccustomed to sheep would be unable to discern the difference by the eye, but the butcher's scales award them a superiority of about 3 lbs. per quarter. These have not acquired any local appellation. They inhabit Skiddaw, Saddleback, the Caldbeck group, the Helvellyn range, and the adjoining mountains.* They are foddered with hay on the mountains in winter whenever the winds will admit, and they well know the appearance of the hay-sheet and the shepherd's call. Some shepherds are at the daily pains of taking a few stones of hay on their shoulders, or on horseback, five or six miles to their sheep-heaf, and thus induce the sheep to keep their heaf in all weathers. It certainly requires a spirited and able-bodied man to perform feats of this kind in windy and stormy weather: but shepherding is too often made an excuse to avoid work. If the mountains, now held in common, were all inclosed or reduced to stinted pastures, much time might be saved in shepherding; and the sheep, by being regulated to proper numbers, would acquire larger bone and be of better quality. Much of the jealousy and bickerings, for which shepherds are proverbial, would be avoided, and the continual overlaps of the flocks and the houndings and disturbances by the shepherds put an end to. And, more than all, each commoner would then enjoy the right he is justly entitled to, and each party would obtain the benefit of the pasturage from which their estates are saddled with tithe-rent charges—neither of which are in all cases possessed at present.

Prizes for sheep are given at all the other agricultural shows of the county, and much enthusiastic competition is thereby created.

For the purpose of recovering and restoring stray sheep, a peculiar kind of book † has been published, and re-issued occasionally with the necessary alterations. This book contains printed descriptions of the ear-marks and wool-marks used in every flock belonging to the mountains. In aid of the letterpress descriptions, wood-engravings of the right and left sides of a

* Mr. Henry Hodgson of Ousby has established a breed of these, which he calls Herdwicks, on the south-western side of Crossfell, and they seem to do as well as the black-faces around them.

† There are now two; one connected with the Eastern division, and the other with the western, and the counties adjoining them.

sheep belonging to each flock are given, showing the ear-marks, the tar-letter, and the position and colour of the wool-marks of each owner so distinctly, that by reference to the book no mistake need be made as to ownership, so long as the sheep retains the original marks, in whatever part of the county it may be found, if it belongs to the district embraced by the book. One or more books are bought by individuals, or by subscription, into each valley, and by their aid stray sheep are easily restored to their proper owners, at the fairs and other periodical gatherings of the flocks.

The Shepherd's Dog.

In all mountain sheep farms the shepherd's dog acts a very prominent part, and especially on the rocky mountains of Cumberland, where travelling is difficult at all times, even to the iron-shod shepherd, but most so in frost and snow, when hundreds of acres which the shepherd ought daily to inspect may be so slippery and dangerous as to greatly limit his excursions. Though at all times the dog's services are indispensable, on such emergencies he will sometimes do the work of twenty persons in patiently bringing down the sheep from places almost inaccessible to man under any condition.

The Cumberland sheep-dog is in no way deficient in intelligence and sagacity, but may compete with his congeners of any country; and, though the usual selling price of a dog of ordinary qualifications does not range higher than 20*s.* to 40*s.*, there are many shepherds who would make almost any sacrifice short of life rather than part with a good dog at any price. One or more sheep, and even a cow, have been offered and refused. In fact, first-rate sheep-dogs are not to be bought. They may be reared or bought young, and may turn out well, but no shepherd of standing will dispose of his favourite on any terms; and even when broken down by adversity, the dog is the last chattel the storms of life compel a feeling man to part with, and then not without evident sorrow.

Well might a popular writer say, "Without the shepherd's dog, the mountainous land in England and Scotland would not be worth sixpence. It would require more hands to manage a flock of sheep, gather them from the hills, force them into houses and folds, and drive them to market, than the profits of the whole would be capable of maintaining." And though this may be more true as regards the wild and headstrong black-faced sheep of the Scottish mountains, it is also correct as applied to our own; and most of the difficulties of gathering and driving will vanish in the presence of a really good dog. The sheep seem to know, as if by instinct, before they have been many minutes under the

charge of such a dog, that all their efforts to break away are fruitless, let the flock be ever so wild and numerous, or the field of operation ever so rugged and unfavourable.

It is surprising to observe what cunning a drove of pure Herdwicks will sometimes exhibit in their endeavours to baffle an ill-trained dog. While the driving or gathering ground is favourable to the dog, all goes on well enough; but no sooner do the wily creatures discover a suitable opportunity, than perhaps one or two break off on one side, and, while the dog attempts to head them, others steal away in different directions on the other side; while the dog attends to them, the mischief increases, and nearly the whole flock will disperse, to the utter discomfiture and amazement of the dog; but if at this juncture the tactics of a clever dog are brought to bear on the flock, in an astonishingly short period the whole of them will be subdued and brought into order, and may be driven without difficulty so long as the master-spirit is within call.

Some dogs have the faculty of discovering sheep when buried to a considerable depth under the snow, as happens occasionally. A dog possessed of this quality is of immediate value equal to the amount of the sheep he releases or marks. A single dog has been known to point out unerringly the locality of many scores of drifted sheep in a day, even when several of them were at a depth beyond the reach of the shepherd's snow-pole. In the great Martinmas snow-storm of 1807 (by far the heaviest fall within the present century), the writer was personally engaged, though very young, assisting to search for and release about 400 sheep, being part of a flock of Herdwicks which had been turned out on the common from the fold late in the evening before the snow began to fall. The darkness prevented them from reaching their known heaf; and the storm coming suddenly, and falling very heavily, the poor animals were surprised at a disadvantage, and nearly all were covered up in hollows, under walls, and other places where they had sought shelter. To add to their confusion, the wind veered during the night, while the snow was falling, from south-east to north-west, and thus all chance of escape was cut off; for those the first part of the storm had left uncovered were drifted under a still greater depth by the enormous masses of loose snow whirled about by the wind, and blown in exactly the opposite direction to that of the first fall. After a fearful night of tempest and of useless foreboding on the part of the family, at daybreak next morning not a sheep of the flock turned out was to be seen, for every one was drifted over, and none could tell where a single sheep was to be found. All hands were put to work probing in the drifts with long poles, and here and there a few sheep were discovered, after much laborious

exertion, and dug out. An untutored sheep-dog, not quite a year old, was one of the party, with three or four older dogs of the same kind. The older dogs took little notice of what was going on, but the young one began to be very curious about the proceedings, and, amid his gambols among the snow, would every now and then return to the working party to peep into and snuff about the holes they made with the poles. In a little time he seemed to take still greater interest in the work, and went from hole to hole, examining and smelling at them as the poles were drawn out. He was purposely unnoticed, to see what the result would be, and to avoid diverting his attention. He remained looking intently into one of the holes after the men had gone to some distance; and all at once a new light seemed to break in upon him, and he began to scratch in the snow with all his might. This was just what was desired; and when he was seen to be in earnest, the men returned and dug down through the drift for 7 or 8 feet, encouraging the anxious whelp, and, deeper than their poles would reach, they found a cluster of five or six sheep huddled close together. When these were released, the dog barked and howled with delight; and no doubt the owner and his assistants felt that the sagacious animal was in a fair way to lighten their labours, as well as to save much property which was in imminent risk. From that moment the dog was the principal, and by far the most valuable actor. For a while he would insist on helping to scratch out the half suffocated sheep; but as he got to better understand the matter, he merely indicated by a few scratches the locality of the buried sheep, no matter how deep they were, and on he went to others, with all the importance of an old hand.

The dog being so anxious, and the peril of delay so great, no cessation of labour was indulged in till evening, when all were obliged to leave the exciting duty from sheer exhaustion and cold. The result of this, the first day's labour, was the releasing of over two hundred sheep living, and likely to live, and about a score smothered. The following day, by the exertions of the same young dog, several more were dug out, some living, but many dead; and few indeed were passed over without being marked by the young creature, whilst the older dogs stood listlessly by, though infinitely more accustomed to sheep, and trained to almost perfection in other duties. Day after day added to the numbers of both living and dead, till finally all were found; but the loss amounted in this lot, and on the rest of the farm, to nearly two hundred sheep. The last living sheep discovered was on new year's day. It had taken shelter in a hollow under a whin,* and had remained in the small space of a 5 feet cave from the 18th of November, with

* Furze-bush.

nothing to eat but what it could nibble from the prickly bush; and when liberated on a bright frosty day, it appeared nearly or quite blind.

The drifted sheep were mostly found in small companies of two, four, six, &c., and those were nearly all got out alive; but when the gatherings amounted to ten, twelve, or more, the poor animals had trampled and crowded one upon another till nearly all died; and the carcases of the dead were mostly flattened, as if they had passed between heavy rollers.

The loss on the farm was not confined to sheep alone. Fourteen highland cattle were drifted over on the same occasion: three of these were lost, and two or three more so crushed and lamed as to be costly invalids for several months after.

Many Cumberland farmers were serious losers * in sheep by that storm; but where a dog was available, with the valuable gift of "marking," much loss was averted.

The dog above mentioned exhibited another trait of intelligence and calculation of a remarkable kind. His master was a constant church-goer, and the parish church was more than a mile distant. By some singular process, the animal arrived at a true knowledge of the day when his master attended church, and of the hour, and almost minute of his leaving again; and was as punctual in going to meet his master about two-thirds of the way.

Another instance, among many, of the sagacity of a Cumberland sheep-dog deserves to be put on record. A plot of low and level ground near Muncaster Castle, called Hestholm Marsh, is usually covered twice in the day by the tide, and sheep were constantly depastured on it, with a field on a higher level to retire to on the rising of the tide; but the stupid animals, being fond of the salted grass, were sometimes surprised and impounded by the tide, and then the dog's services were requisite in the rescue. In a little time he learned to go down and clear the marsh of his own accord, as constantly as the tide flowed during daylight; and thus was the means of preventing all loss by the waters, so long as he was able to attend to his self-imposed duty.

There may be little remarkable in dogs executing duties occurring daily and at the same hour. Many dogs have learned to bring the cows home at the regular milking-hour, without special directions; and one † well known by the writer performed this

* Amongst others Mr. Mossop of Thornholm, whose dog marked some hundreds of sheep, and also the bull which was buried at the great depth of 35 feet, and could not be got out to be skinned before the 1st of May in the following year.

† Mr. Walker's of Gill, near Egremont. When the dog happened to be from home with his master for a day, the bull could not be ventured out to water. And so perfect an ascendancy had the dog gained over the bull, and knew it so well, that he never permitted it to stray more than a few feet out of the direct road;

service with great punctuality for many years, as well as hastening home from other work every day, to be present whilst an unruly bull was let out to water.

There is an old saying, and one not devoid of truth, that "the laziest shepherd invariably has the best dog;" but necessity is as powerful an agent in this case as indolence, for no shepherd can have better-trained dogs than the one at Stockhow Hall, who has numbered four-score years, and whose daily range few young men would willingly undertake. Another old man, a rheumatic cripple,* almost unable to walk, and mounted on an ass from morning till night, has the sole care of a large stock farm; and, with the aid of his two dogs, can ride into the flock in any part of the fields, and lift a sheep before him on the ass and ride away with it.

Pigs

Have been brought as near to the standard of perfection in this county as any race of domestic animals, and the improved white breed has been successful in the national shows. The large and coarse animal, with broad hanging ears, so common forty years ago, is now in few hands, though it is found still useful in improving the size of and imparting constitution and hair to the smaller breeds.

The usual system of fattening pigs, on a liberal allowance of oatmeal paste, gives a firmness to the pork, and a solidity and fine flavour to the hams and bacon, when dried, which cannot be easily excelled. Barley-flour and other substitutes are occasionally used with success in feeding, but some of them cause the fat to be soft, even when well fed and long dried.

Poultry.

The poultry are as various in breeds and crosses as can well be conceived. From the rising interest attaching to them, through the prizes offered at the different shows, and the endeavours of several amateurs, the pure breeds are becoming more prevalent. Some geese are reared at the edges of the mountains and on moory pastures, and many are imported from Ireland in the autumn to feed on the stubbles. Few turkeys are bred or kept in the county.

Till of late years, a few hundred acres of the sandy ground along the whole extent of sea-coast were devoted to warrens for rabbits. These are now chiefly cultivated, and rabbits are rarely found, except a few in some of the game-preserves.

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and, while drinking, would sit on a particular stone within a yard of the bull's head till he had enough; and if the bull lifted his head from the water, done or not, he must go home.

* Shepherd for Mr. Johnstone, of Dean.

Pastures and Grasses.

The better class of old pastures are as well covered with valuable grasses as those of other counties on similar soils, with the exception of the limestone soils of Yorkshire, and parts of Westmoreland. There the hay grown on the best limestone soils will feed cattle fat with very little assistance. The very best hay Cumberland grows will not do this, or approach near to it. Their mowing-grounds on the limestone are full of rib-grass and other leafy herbs, which here appear too weak and tender to contend with the hardier grasses, and grasses chiefly form the basis of our old pastures on nearly all soils; yet their summer-feeding qualities are superior to those of the hay grown on the same lands. This may be in part attributed to the late period of the season when our hay is usually cut. The grasses are then at or beyond maturity, and their most valuable constituents have been applied towards perfecting their seeds. Our grasses being seldom sufficiently advanced for cutting in June, we have no alternative but waiting till the more rainy month of July.

A high authority* says 1 bushel of mixed grass-seeds per acre "will afford but 2 seeds to every square inch, while the most productive ancient natural pasture examined had 7 plants to every square inch;" therefore 3 bushels of seed per acre will not be too much for properly covering the land with herbage, according to his researches. The examination of a sod taken from some good neighbouring pasture, when the grasses are in flower, will best explain the kinds adapted for similar soils, and if carefully numbered will give a near approach to the proportions of seed required. The kinds and quantities will of course vary according to soil and other circumstances.

An excellent mixture of seeds for permanent pasture on good soils is formed of—

No. 1.—Perennial Ryegrass, *lolium perenne*	$\frac{1}{4}$	bushel.
2.—Rough Cocksfoot, *dactylis glomerata* . .	$\frac{1}{4}$	,,
3.—Meadow Foxtail, *alopecurus pratensis* . .	$\frac{1}{2}$	,,
4.—Meadow Fescue, *festuca pratensis* . . .	$\frac{1}{4}$	,,
5.—Rough-stalked meadow grass, *poa trivialis* .	2	lbs.
6.—Smooth ditto, *poa pratensis*	2	,,
7.—Fertile meadow grass, *poa fertilis* . . .	2	,,
8.—Timothy grass, *phleum pratense* . . .	3	,,
9.—Crested dogstail, *cynosurus cristatus* . .	2	,,
10.—Ribgrass, *plantago lanceolata*	3	,,
11.—Cow-grass, *trifolium medium*	7	,,
12.—White clover, *trifolium repens*	4	,,
13.—Sweet-scented vernal, *anthoxanthum odoratum* .	2	,,

These may be varied of course, to suit circumstances. As, for

* Sinclair.

instance, No. 8 is better adapted to peat or clay soils than to limestone; 11 does not answer on clays or peat, but thrives well on limestone; 3, 4, 5, 6, do best on deep meadow soils; and all the rest succeed on land in good condition, if naturally dry or well drained. The above list is intended for being sown about May-day, or, if that time be missed, at the end of July on well-prepared land, and without corn-crop. Where the land will bear treading with sheep, the addition of 2 lbs. of rape-seed, or half a bushel of Italian rye-grass per acre, will afford shelter to the young grasses in hot weather, and forms an excellent ingredient in the pasture during the first year for sheep. This is found to be a superior mode of laying down land for pasture, and is fast gaining ground over most of the country.

Persons wishing to sow down land for permanent pasture or meadow, and having a portion of prime old grass land, should be at the pains of railing off a part for seed. As soon as the first of these grasses ripen, a part should be cut; and in ten days, or a fortnight after, another part; and so on till the latest grasses ripen. These, harvested as they become ready, thrashed, and the whole of the seeds mixed, will be certain to suit the climate, and any soil approaching that on which they grew. This method would also insure that grateful variety of aromatic and other plants found on rich pastures, *which no one thinks of sowing* with his grasses.

The common method of sowing land down with a corn-crop is to give 1 bushel of perennial rye-grass, and from 6 to 10 lbs. of the clovers, trefoil, and rib-grass, in various proportions. This allowance seems sufficient for the hay-crop, but is deficient, both in quantity and variety, for pasture in the two following years.

For one year's hay-crop, and one or two years' pasture, the following is suitable :—

Perennial ryegrass	1 bushel.
Italian ditto	$\frac{1}{2}$,,
Rough cocksfoot	$\frac{1}{2}$,,
Timothy grass	$\frac{1}{4}$ stone.
Red clover	5 lbs.
White ditto	$\frac{1}{4}$ stone, per acre.

The Italian rye-grass and red clover disappear after the first year, and the rest form a thick sward of longer continuance. For a crop of hay alone, it is sufficient to sow—

Perennial ryegrass *	1 bushel.
Italian ditto	1 ,,
Red clover	8 to 10 lbs. per acre.

Sown grasses are now more frequently depastured than in

* Annual rye-grass is hardly to be met with in the seed shops, and when found, is neither cheaper nor better.

former years. This is only a recent practice in several parts of the county, and is hardly known in others, but is very properly gaining ground. When sown grasses are well kept down in the early part of the year, the stock fed thereon returns sufficient to the soil to keep it nearly in the same condition; but if suffered to run to seed, every root and stem is doing its utmost to accomplish the provisions of nature, in drawing sufficient from the soil to bring its seed to maturity in its accustomed season. It is surprising in what a short space of time the pasture can thus be irremediably injured. A week or ten days of under-stocking at that season is such a costly oversight, that even manuring is hardly sufficient to restore the loss till after the next breaking up and resowing. F. Featherstonhaugh, Esq., of Kirkoswald, most judiciously practises manuring his seeds, immediately after harvest, with a rich compost of steeped soil and rotten dung, and is amply rewarded in the hay and pasturage of the following years.

Bailey and Culley say, "We were informed that, in 1752, no person in the county had thought of sowing a field down with clover or even hay seeds; and that Philip Howard, Esq., of Corby, was the first who sowed a field with clover." Half a century after the above date, very little seed grasses or clovers were sown, while now it would be rare indeed to find an instance of omission. There was an old saying that "twitch is the mother of grass;" and some time after the period last alluded to, the adage was acted on by leaving the land, after repeated crops and no cleansings, to recover itself to grass in the best way it could,* and wretched pastures were the inevitable result.

Few, if any of the old pastures that have ever been under the plough, are able to retain their condition without occasional aid, and it would be an act of folly, in our wet climate, to plough such now. The best restorative of exhausted pastures in Cheshire and some other counties is crushed bones; probably, for want of example nearer home, these have been little tried here. But the experiments of the author with bones on old grass† have not been attended with successful results. Lime is the usual restorative or stimulant on old pastures, and if the application is liberal (from 180 to 300 imperial bushels per acre), and the period since the last liming not less than twenty years, the effect is generally remunerative.

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* Formerly Cumberland soils had the reputation, among farmers, of being "grass-proud," that is, being disposed to run to grass, under all circumstances. This would still be the case if the weeds were all left in the ground, as then.

† W. Browne, Esq., of Tallantire Hall, writes on this subject:—"I may venture to remark that I have tried ground bones as a top-dressing both to old pastures and to meadows without any visible result, though in two cases I covered them with some compost. Ploughed in they answer admirably, and I notice their effect on the pasture when laid down for years after."

The growth of Italian rye-grass in small patches, for soiling purposes, is gaining ground, and seems justly approved when carefully followed up after each cutting with liquid manure or guano, &c. It answers best when sown without a corn-crop at the rate of 2 bushels of seed per acre on turnip land or other clean fallow in good condition. It is not necessary that the land should be of high quality, for it will succeed on inferior soil if well drained and manured. The writer's experience with it is in favour of mixing the seed with one-third of a bushel of spring vetches, for cutting along with it during the first summer; and with 10 or 12 lbs. of red clover, which comes in for the second year's cuttings, and is useful both as an addition to the crop and as a variety of food for the horses or cattle to which it is given.

Lucerne is grown to some extent in the neighbourhood of St. Bees, where it was first introduced by Mr. Carter, and there are small patches in other parts. Mr. Carter sows 14 lbs. of seed in April along with the barley-crop, on light soils with open and dry subsoils, where the roots may penetrate several feet, and carefully avoids sowing it where either clay or water, even in very small quantity, exists. He does not sow any grass seeds or clover with it; and after cutting three or four times annually for a few years—covering with compost and harrowing well every year—he ploughs again for oats. His horses thrive and do their summer work as well with green lucerne alone as they formerly did with other food and a fair allowance of corn. It makes excellent hay, and ought to be much more extensively cultivated than it is. The dry soils of Brampton, Irthington, Hayton, Wetheral, &c., are well adapted to the growth of lucerne, but there it is a perfect stranger. Cows have been found to gather flesh quickly when fed on lucerne in the house, but to diminish in their milk, and to recover again on grass. Horses, cows, pigs, and poultry, are all fond of it, and all thrive well on it. The seed has been known to miss occasionally, even under favourable circumstances, and it is liable to be destroyed in its young state by slugs and insects; but its great value renders repeated trials desirable.

In the summer of 1851 the writer noticed a few plants of the *cynosurus echinatus** growing among his Italian rye-grass on a clayey loam, and regarded it then only as a botanical rarity, but its rapid growth and broad, luxuriant herbage, induce him to expect a more valuable result from a trial he is preparing to

* Mr. Dickinson of London (to whom a specimen was submitted, and whose celebrity as the improver of the Italian rye-grass is known over the United Kingdom) pronounced it as likely to rival the *lolium italicum*. Should this essay ever be honoured by publishing, it is hoped that sufficient trials may be made of this new candidate for favour.

make on a small scale in 1852. The growth of this grass was quite equal to that of the Italian rye-grass, and its juices of a highly saccharine quality, judging by the taste.

Farm-Houses.

Bailey and Culley, in their survey of the county made in 1805, say that "through the greatest part of the county the *farm-houses* are remarkably well built of stone;" and, in a note, add, "except a small district in the neighbourhood of Abbey Holme and the north-east extremity of the county, particularly in the parishes of Bewcastle, Stapleton, Kirklinton, Kirkandrews, and Arthuret, where they are mostly built of mud or clay, and form a miserable contrast to the buildings in the other parts of the county." They might have added Scaleby, Rockliff, Brough, Drigg, and a few others to the list of parishes enumerated above, and also that the mud-walled buildings (provincially termed "clay daubies")* were almost invariably roofed with thatch, consisting of straw, rushes, or heather.

These old farm-houses, judging from the samples still existing, and from recollection of numbers pulled down and rebuilt, once the residences of our forefathers, were of a very humble description. In those parts of the county where stone suitable for building purposes was scarce, or, from the deficiency of proper quarrying implements, difficult to procure, and which the sledges and pack-horses of the day were ill-qualified to remove, recourse was naturally had to such materials as were most at hand. In those places, wood and clay being more plentiful, buildings of those materials were constructed, by first erecting the main timbers. These timbers, corresponding with what are now called principals, were then called couples, and consisted of two trees chosen with natural bends. These, when pinned together at the smaller ends, and set up in a triangular fashion, with the butt-ends let into the ground, and the curves bending outwards below, were again fastened by a cross-beam, high enough to admit of persons walking under it. The cross-beam in the outhouses was called the jenny-bauk, from its being the usual domicile of the barn owl.

When a sufficient number of these couples were set up and connected by pannions—all being of half-squared oak—the clay walls, tempered and mixed with straw, were begun upon the surface of the soil, and carried up to "man-height," that is, 6 or 7 feet, and then roofed with split oak rafters and thatch. The doors and window-holes were small, on the principle of a small entrance being more easily defended than a larger one, light

* The old clay walls, when broken down and applied to the land, are found to be excellent manure.

being of little importance in dwellings where the domestic operations were simple.

The fire-places were on the ground, and extended nearly across the end of the building, with wide and open chimneys, through which the sky might be seen, and where the rain entered freely. The inside of the spacious chimney was the curing-place for hams and other joints, and across it was a small oaken beam,* from which the pot-crook was suspended, and on which the rats were accustomed to disport, and annoy the inmates by the soot they displaced. These clay houses were warm enough, but too close to be healthy when the doors were closed.

Some few examples of such buildings, in all their primitiveness, may yet be seen; and, being specimens of the common residence of the laird,† the yeoman and the cottar "of the olden time," should not all be extirpated till we can properly appreciate the comfort of better dwellings.

The plan originally followed in erecting these houses was a long range‡ of building, without any lofts. When the border disturbances partly ceased, greater cost in building and increased conveniences were indulged in, though not without the risk of incurring loss from marauding parties of moss-troopers. And to guard against these, many stone-built detached farm-houses, dating from 1600 to 1750, are found, forming squares, with a fold-yard inclosed to hold the cattle; the entrance being an archway with knobbed oak doors, and the dwelling fronting into the yard. After the latter date the precaution of the inclosed fold-yard was omitted, under the comfortable feeling of greater security; and we find the buildings more separated as convenience or fancy dictated, or the wants of the occupiers required. When corn began to be cultivated in such quantities that some farms had a little to spare, the barns were constructed with a small door directly opposite to the larger entrance, for the purpose of creating a draught sufficient to winnow the grain as it was poured over the edge of a "weyt,"§ or a wooden shovel. On fine days the grain was removed into the field to the nearest elevation, called the "deetin' hill," and there deeted or winnowed. These methods have been practised on many small farms till within the present century.

Few houses are now met with that are not built of stone and

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* The rannel tree.

† The barons' and esquires' residences were mostly fortified halls and castles.

‡ A barn at Salter Hall, and another at Grange near Egremont, were of nineteen lengths of timber. The former originated the saying "as long as Salter Leathe." The latter stood at right angles across the highway, which passed through an archway in the centre.

§ This was a kind of shallow dish made of a sheep-skin fixed over a narrow hoop, and used in the barn work solely.

lime, or brick and lime, and roofed with blue slate; or, where sandstone of good quality is found in thin laminæ, or admits of being split, it is occasionally used, and makes a strong but heavy roof. In a few of the mountain vales the dwellings and farm buildings are of stone without lime. They are dry and substantial, but admit too free a ventilation even when plastered within.*

The open square form of ground-plan, with the dwelling forming one side and the out-offices the other three, and the dung-heap in the centre of the inclosed space, is the most common arrangement of the modern farm-yard. The back of the barn is placed against a rising ground when convenient, and the entrance for carts is then on the level with the loft barn, the cow-houses, &c., being below it; the building is then said to be under-housed. On level sites this is effected by an artificial slope. On the large farms the different buildings are kept more distinct.

A better system is to have the houses containing the fodder and roots placed centrally, and the feeding-houses on each side, with the manure depôt at one end of the whole.

After the transition from war to peace, in 1815, had told its disastrous tale on the profits of agriculture, it was remarked to the writer by a shrewd Yorkshire grazier, who supplied his pastures from this county, that "Cumberland yeomen built themselves out of doors." The remark was not altogether devoid of truth as applied to that period, for many built expensively when both produce and building materials as well as labour were high, which they had cause to regret when the reaction took place; and instances may be found where the estate, including buildings, has been sold for little more than the cost of the buildings alone. Happily these instances were rare.

Most of the farms on the estates of noblemen and gentlemen of fortune are respectably built, and the upper and middle yeomanry, provincially termed "statesmen" in the county, have studied both comfort and convenience on rebuilding their homes, whilst the smaller proprietors have been less able to spare enough for those purposes without infringing on the claims of their families.

Beyond a walking distance for labourers from towns and villages, a want of cottages, and consequently of their inmates, is in some districts experienced; but this is an affair which those who feel the want will in time find a way to remedy.

The situation of the farmstead is often injudiciously chosen. In villages, where the farms are intermixed, convenient sites are difficult to find. On detached farms the ancient localities are in most cases rebuilt upon, with the economical view of reserving the best portions of the buildings; and the original sites have

* Floors and stairs of polished oak are to be seen in many farm-houses in the mountain vales, and knobbed oaken doors, without paint, are not scarce.

been often chosen for convenient access to the common or peat-moss.

When the commons were inclosed, houses, before conveniently placed as to roads—such as the period then afforded—were some of them found at less convenient distances from the new ones. A spring of water may have determined the locality of some; and shelter, or a view, may have influenced the situation of others. In few instances do we find the centre of the farm selected, where time and distance might best be economised. To be near a public road is no trifling advantage, but a greater still is to be in the centre of the every-day action.

Fuel and Peat-Mosses.—Coal, which is found in several parts of the county, and is now easily procured, has almost everywhere superseded the use of peat as fuel; wood is partially used where it is plentiful and coal scarce. No land which at a reasonable cost can be laid dry enough for agricultural purposes is now reserved for peats.

It is recorded in an ancient court-book belonging to the manor of Derwentwater, dated about three centuries ago, that a tenant named Wren was fined 13*s.* 4*d.* for having two fires on at the same time in one "toft" (house), the custom of the manor then not permitting the tenants the use of more than one fire at a time in the same house, as a means of preventing the undue consumption of the peat-bogs.

Scaleby Moss,* which till lately supplied most of Carlisle with peats, is now nearly exhausted, and is being converted into arable land.

In 1771 an eruption of Solway Moss occurred during a dark November night, at its south-eastern edge, overwhelming by a torrent of black mud upwards of 500 acres of land belonging to the Netherby estate, stated to be the "pride of the country" in its agriculture, and the residence and maintenance of twenty-eight families, all of whom lost their whole possessions by it, and had the world to meet anew without a penny. Their farms were covered several feet deep, their houses and furniture overwhelmed by the weight, their cattle and crops smothered and destroyed, and the face of the country so changed that when daylight came the bewildered fugitives could not recognise their own habitations or farms. This amazing mass of peat-earth was removed in the course of a year or two, by a simple yet ingenious method of

* On the 25th May, 1845, the skeleton of a woman, evidently of ancient times, was found by a peat-cutter in Scaleby Moss, imbedded eight or nine feet in the peat. It was wrapped in what appeared to be the skin of a deer, which was formed like a garment, and had evidently been worn, as the hair was rubbed off in several places. It was composed of different pieces, united by seams, which had been executed with considerable neatness. The fine black hair, which was quite as long as that worn by the females of the present day, was much admired.

flooding, by which the whole of it was gradually conveyed down the river Esk into the sea, and the fine tract now occupied by the capital farm of Smalmstown and parts of some others restored to its former fertility.

In 1758 Solway Moss contained 1700 acres, having a fair appearance of heather and moory grasses on the surface, but a perfect mass of fluid moss under it. By improvements in draining, &c. round the edges the area is now reduced to 1070 acres, and this has chiefly been done in the last thirty years.

The margin of the moss has been strengthened at the scene of the notable disaster before mentioned, and for a considerable distance along the edge by a belt of trees, the roots of which, interlacing below the surface, hold the soil together. Had it not been for this precaution another burst might have occurred lately, as the bank has evidently been moved nearly at the same place by the pressure of the fluid contained within the moss; but fortunately the net-work of the tree roots proved strong enough to resist its force. The depth of the moss ranges from 14 to 20 feet, or more; and though it is believed that nearly the whole of the thousand acres it is now reduced to might be drained (at an enormous cost), it is the opinion of Sir James's intelligent land-steward* that, owing to the surface of the moss, to the depth of nine feet and upwards, being of very inferior quality, it could not be improved or cultivated to advantage.

Where the edges are not protected by planting, the cottars are permitted to cut peats for firing on payment of a small moss-due; and it is observed that as the peats are cut away, the edge of the moss is constantly driven forward to about the same place by the weight and pressure within, so that the space covered remains nearly the same; and this outer edge continues to solidify as it advances, so as to become firm enough for making peats at any time.

Mr. John Irving has recently leased about 30 acres at the edge of this moss, where the peat has been partly cut off, and is in the act of improving it by draining and claying the surface. The clay forms the lowest subsoil of the moss, the intervening strata being hungry sands, of no use, but rather detrimental when applied to the surface. This trial has not proceeded far enough to show the result.

There are other peat-mosses in various parts of the county, and all those in the lower districts are undergoing more or less improvement. Some have been drained and converted into arable, and some into meadow or pasture. Fifty years ago a great part of the now very fertile meadows in the valley extending from Whitehaven towards St. Bees were peat-mosses, full of

* Mr. M. Brown.

holes from whence peats had been dug. They were then a fruitful source of fever and ague; and the late Dr. Joshua Dixon attributed the greater part of the sanitary improvement of Whitehaven since that period to the effective drainage of these meadows by Mr. Benn, the agent to the late Earl of Lonsdale.

Since the use of coal became general for fuel, peat-mosses have been considered of little value in this county: but the Earl of Lonsdale's recent experiment on Bowness Flowe gives the affair a more promising aspect. Such mosses as are still in a state of active vegetation with the *Sphagnum* family of plants, are totally valueless in their present state for all except the sportsman's purposes. Those which have ceased growing and are black and compact with age and decomposition produce ashes which are prized by the cottars as of a very fertilizing nature for their gardens; but the ashes are invariably small in quantity compared with the bulk of peat consumed, and their enriching effect is of short duration.

It might be worth while to call in the aid of science to ascertain the best mode of manufacturing ashes on a large scale, as well as their true value as manure. Large quantities of peat ashes are used in Holland, which are mostly brought down the Rhine from Germany, and are extensively applied to manure the crops. They form a considerable article of traffic in Belgium for agricultural purposes.

In Ireland dried or charred peat seems likely now to be turned to a profitable account as a disinfecting agent, and as such is partially in use on some Cumberland farms.

In various parts of the county peat is found, which (the water having been abstracted by some cause or other) has become a black, friable earth. This is nearly akin to *humus*, and, when dry, is such an excellent absorbent of farm-yard liquids as to become when thus saturated little short of manure itself. If peat can be so prepared as to mix with and absorb the fæcal accumulations now wasted in the sewers of our great cities and towns, an almost unlimited supply of fertilising matter might be obtained at a cost comparatively insignificant, and as valuable as guano, and certainly greatly superior to many of the chemical nostrums frequently advertised. The subject is well worthy the consideration of those having peat-mosses on their estates, as many of them may contain the source of fertility within themselves, derived from what is at present not only unprofitable, but, as in the case of Solway Moss before alluded to, dangerous and injurious.

Woods and Plantations form a portion of the rural economy of every county (but in which the tenant-farmer has a very limited interest, though the surface occupied in this way is not of small

extent). Every landed gentleman's seat has its scores of acres of natural woodland, or of recent plantation, or both; and some estates have hundreds of acres covered with wood.

The extensive tract of country from Bowness to Maryport is comparatively bare of plantations, from an impression that timber will not thrive within reach of the sea-blast. It is true the south-western gales act injuriously on timber-trees and hedges for a considerable distance in-land,—as far or further than the spray* of the sea is usually carried by the winds; but this ought not to deter landowners from planting clumps of trees in corners and waste places, for the sake of shelter; and wherever an estate having a western exposure is sheltered in this way, the occupier finds a benefit in the posts and rails it produces, as well as the protection it affords to his cattle and crops; and even at the reduced prices of bark and timber there are few woods which, properly managed, do not pay as well as if the land was in grass or tillage. The bobbin-mills scattered over the county find ready consumption for the refuse of all kinds of wood which does not injure the thread by its resinous or colouring matters. Farmers find posts and rails cheaper for fences and their repairs than the old system of "stake and rice,"† as it is more readily put up and lasts longer.

Larch and other kinds of wood suitable for props and sleepers are in daily use in the coal and iron-mines, and much larch timber is now used for implements of husbandry, which were formerly made of ash.

Since 1790 scarcely a common has been inclosed, but the allottees have found nooks and corners for planting, and have thereby improved the appearance of the neighbourhood and of their estates at the same time. In former times almost every "statesman's" house had one or two yew-trees growing near it, from which he could at any time supply himself with a bow, for the purposes of aggression or defence. In the present times the larch is his guardian tree, but its uses are all for purposes of peace.

There is a district, commencing about Kirkbampton on the west, and extending eastwards by Nealhouse, to Broadfield and the country formerly occupied by the Royal Forest of Englewood, which seems peculiarly adapted to the growth of the Scotch fir; for wherever that tree has been planted, and has attained sufficient growth to produce seed, there the young firs rise spontaneously, and if suffered to grow, soon cover the ground. On the poor

* In the January storm of 1839 salt spray was carried by the hurricane as far as Kendal from the western coast.

† Called "cock-guard" in some parts; in others "winding," "stower and yedder," &c. &c.

black-topped soils of what were commons the Scotch fir is the only plant that will thrive properly, which is the reason that so many were planted. The late Mr. Liddel tried several varieties of trees in his extensive plantations near Carlisle (towards Kirkbampton), and found nothing answered so well as the Scotch fir. The late Rev. Mr. Matthews, of Wigton, also tried the larch and other trees in his plantations, on what was Wigton Common, without success: so that on such sort of uneven land it is not a matter of choice, but of necessity, that has induced the planting of Scotch fir so extensively.

Most of these sandy soils are too shallow, as well as too poor, for the more valuable kinds of deciduous trees, and contain a considerable portion of a ferruginous gravel, intermixed with an oxide of manganese, which may account for their barrenness as well as unsuitableness to the growth of timber.

However this may be, the Scotch fir (*Pinus sylvestris*) alone seems to thrive; but it is greatly to be regretted that in the selection of this class of tree, which has been so extensively planted in East Cumberland, a better variety was not adopted: for, from a treatise by Mr. MacGregor (to which the Highland Society awarded their silver medal in 1837), we find that the native pine growing in the old Scotch forests is vastly superior in quality to what is generally raised and sold by nurserymen. The latter is supposed to be of American origin, and the true Scotch fir has been distinguished from it by the designation of *Pinus sylvestris horizontalis*. Its growth seems slower than the kind commonly planted, and its branches more horizontal. It is said to bear smaller cones, and fewer of them, which accounts for the inferior variety being more generally propagated. There seems to be no doubt, however, of its vast superiority as timber, as the timber from the forests of Abernethy, Rothiemurchus, Glenmore, &c., sufficiently testifies; and as an instance of the size of these trees in their native soil, we find a table presented to the late Duke of Gordon, made of one single plank, 5 feet 5 inches broad. It is needless to observe how infinitely more valuable these extensive plantations, which now ornament the country, would have been at this time had the plants been raised from native seed.

Many of the bleakest districts of the last century are now studded with plantations, which are highly beneficial in their several localities; but very many over the eastern division contain too great an admixture of the Scotch fir. The larch is a more valuable kind of tree as to timber, and affords as good a shelter when planted in a body as the Scotch fir, but does not thrive long, except in dry soils.

The oaks of the mountain-valleys produce timber which turns quite black with age, as may be seen in the boarded floors of

the old farm-houses. These bear a polish by frequent rubbings, equal to that of the hardest marble; and the period of their endurance is yet unknown, but must be mostly coeval with the buildings in which they are found.

In 1850 the experiment was tried on the estate of Col. Youngson, of peeling a great quantity of Scotch fir-trees, for the purpose of making the carriage lighter by railway. A month after the bark was taken off, the reduction in weight, including the bark, amounted to 20 per cent. The object of economy in transport was effected, and the timber was thought to be tougher, and of better quality than that with the bark on. Whether it may last as long is not yet proved.

Where shelter is desirable on exposed situations, it may gradually be obtained by commencing to plant a belt on the exposed side. When these have rooted well, and risen so as to afford a little shelter, another strip may be planted along the less exposed side. This may be followed year after year by successive plantings, increasing the width annually, till the ground is covered. The third and fourth plantings will soon overtop the first, and make more timber in a given time than if all had been planted at the first.

Another successful method is to plant spruce or Scotch fir thinly, and as they rise, to fill up the spaces with the kind wanted. The soil and situation must be bad indeed, if the spruce and Scotch firs do not make a tolerable growth during the first ten or fifteen years. They might then be thinned out, if thought desirable.

Preserving sawn Larch timber, &c.—Larch-wood being so readily grown on almost any soil, to a size useful for agricultural purposes, and being so convertible to various uses at a cheap rate, has become one of the most serviceable kinds of timber now grown; and its preservation by cheap means, when in use for gates, hurdles, rails, posts, palings, timbers, laths, flooring, and various other purposes, is a matter of very considerable importance. Different methods of preservation are in use in the county —the cheapest and most manageable being steeping the planks or sawn timbers in lime-pits. This is only effectively done when the timber is in the green or unseasoned state: the lime in solution then combining readily with the watery portion of the sap, and filling or lining the pores of the wood therewith, and on drying, rendering it so hard as to be planed with difficulty, and giving it the property of several years' additional durability in a sound state. The process is very simple, for the wood only requires to be sprinkled with hot lime in powder, and after remaining a short while, to be thrown into a pit or tank of lime-water, made so strong as just to deposit the heavier particles of

lime, and to leave the solution tolerably clear. The planks, &c., may remain in steep for two or three weeks (a little hot lime being now and then thrown in), and should then be taken out and set up to dry awhile, by way of reducing the great weight acquired in steeping. The process seems within the means and accomplishment of any farmer, and especially as no accuracy or proportion is requisite. The tank need be no more expensive than a hole dug in the ground, and lined with clay to make it water-tight.

Another cheap preservative in use is tar from the gas-works. When this tar is applied cold to larch, rough from the saw, and in cool, dry weather, it hardens on the surface, and forms a varnish impervious to wet, and not liable to run in hot seasons. The quantity of tar required when applied in this way is rather considerable, but it is a cheap article in a raw state. Some prefer boiling the tar, along with two ounces of powdered resin to the gallon, and applying it hot. This is also an efficacious method, and requires less tar.

Paint is generally preferred, because customary; but a great proportion of the out-door wood-work is not allowed a covering of any sort. Gas-tar possesses the property of being in part absorbed by the wood, and its preservative quality is thus superior to that of any of the oil-paints used.

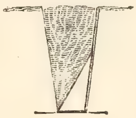
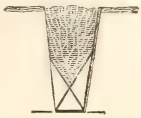
V. Draining,* the extent to which practised, and is still required.

Little draining of any kind was practised in the county till near the end of the last century; it was too expensive for the tenant-farmer to take in hand, and the gentleman landowner of that period seldom paid much attention to the improvement of his estate. In the latter half of the century, here and there a "statesman" farming his own property took in hand, at distant intervals, to put in a few roods of drain at a vacant time, to carry off the water from a wet patch of his arable land; but it was deemed almost an act of impiety to attempt to deprive a bit of meadow or pasture land of its superabundant moisture, so long as it was not dangerous as a mire.†

* In 1805 Bailey and Culley were "glad to observe, in many places, great advantages gained both by hollow and surface drains; some done with great art, by one or more hollow drains running in the direction of the outburst of water, and cut deep enough to get through the bed of sand or gravel in which the water runs, and by that means arrest the source, which drowns the land below it; but the like intelligence has not in all places prevailed, for we often saw the drains run in parallel directions, *perpendicular to the source*, and at such distances as the drainer thought the nature of the soil required: this is more particularly the case where surface drains are used. The hollow drains are filled with stones when they can be got, otherwise with sods."

† The cry of "run wi' t' reapes (ropes)—a cow i' t' mire," was very common in the early part of the present century.

These early drains were usually about 2 feet deep, placed with "sets and chocks"—that is, stones set up against the sides of the drain, and wedged with a larger block, and then filled with smaller stones, till they could occasionally be touched with the plough—some having an idea that a shake with the plough now and then tended to keep the stones loose and the drains open.

Where brushwood was handy and stones scarce, the thicker branches were cut into lengths, and set sloping against one side of the drain, thus :—  , or crossed— 

and the upper space filled with the smaller branches, over which a thick sod was laid and trampled down, and then the remaining space filled with soil. Some drains were filled with brushwood at random, without any special opening at the bottom.

The wedge sod-drain was in partial use in the stiffer mossy soils, and all were very imperfectly planned and executed, when compared with the drains of the present day.

The great aim of the old drainers was to cut off and intercept the water flowing down the slope, by drains conducted diagonally or directly across the fall. This was carried to such an extreme, that some who thought they understood draining better than others, would only allow as a rule an inch of fall to the rood of seven yards, whatever the declivity of the surface might be. This was the most usual method; but there were still some few who were laughed at for their ignorance or obstinacy in persisting to give their drains the greatest attainable fall, as is now commonly practised.

Early in the present century the late Mr. Curwen, of Workington Hall, gave a powerful impulse to draining by offering premiums and prize cups for the greatest number of roods of stone drains executed on any farm. Among others who received draining prizes was the late Mr. Dawson, of Shatton, near Cockermouth, whose prize cup is dated 1811. A trustworthy neighbour of his, who is still living (1852), was called in to measure and certify to the quantity of drains, and he informs the writer that these drains were mostly 2 feet, and from that to 5 feet deep, walled, covered, and filled to about a foot from the surface, with stones. One of the fields * drained was 10 acres and 28 perches, and the drainage of the 1000 roods of drains cut in it cost 300*l.*

* The writer examined the land in the autumn of 1851, and found it in want of re-draining, though the stone drains were discharging a great quantity of water, and appeared to have been well executed. The land is now certainly not worth the cost of its drainage in 1811.

Another smaller field was also drained, of which he does not recollect the extent or cost; but the whole length of drains in the two fields was 1700 roods.

The late Mr. Dalzell, of Stockhow Hall, and others also, received draining prizes about the same period; and greater merit was then awarded to the extent executed than to the quality of the work. The system then generally prevailing was the diagonal.

In 1821 Sir J. Graham brought an experienced tile-maker from Staffordshire, and established the manufacture of drain-tiles on the Netherby estate—this being the first attempt of the kind in the county.

A considerable degree of doubt and suspicion existed among the tenants and others that the small cavity of the tile might be insufficient for its intended purpose, and that its thin substance and fragile nature * were not calculated for long endurance. The confidence which Sir James exhibited in the success of his plan, the large amount of money he expended in it, and, above all, the great improvement so quickly developed in the land on which he operated, soon induced his tenants to enter into his views, and to cart and put in the tiles (which he supplied gratis to them) under the superintendence of his agent; and in this way 40 miles of drains were annually executed for some years. The success of this experiment set others to think about it, and in 1824 other tile-works were begun. In that year Mr. R. Lucock established the first tile-work in the western division, and soon after, the encouragement he met with induced and enabled him to commence other works, and by degrees the manufacture spread over the county.

About 1835 the mania for shallow draining began to exhibit itself, and soon arrived at an absurd pitch. The depth was gradually lessened to 20 inches, and even to 18 and 16 inches, and many hundreds of acres were attempted to be drained in this very imperfect way. The rapidity with which these shallow things could be executed led people to try it who ought to have known better; and after it had been practised for a few years, the discovery began to be made that an immense expenditure had been incurred, and a great deal of harm done. The tiles being so near the surface, carried away the rain-water and manure held in solution by it, while the subsoil remained as wet and destructive to the crops as ever. On several farms the deep ploughing of modern times has occasionally torn up tiles from the shallow drains, and at once, if other reasons had been wanting, led to the conviction that deeper drains were necessary. The doctrine of deep draining

* A tenant of Sir Wastell Brisco actually refused to allow his landlord to put in the "pot things," as he called them, on his farm at Spittal near Wigton.

was begun to be written about in the periodicals of the day, and the farming public, beginning to lose confidence in the experience of the past, and being now a more reading and reasoning community, and willing to inquire into and adopt any system having probability to recommend it, readily fell into the conclusion that the deep drain must be the most effectual remedy for the defects of the shallow one. The 5-feet drain, as first recommended by Mr. Parkes, was adopted by a few and forced upon others; but it was soon found that its universal application could not be a general remedy. And now, no man who either values the opinion of others, or regards his own interest, *will venture to prescribe the depth of his drains till he first ascertains the nature of the substrata*, and has found in which of the strata the most water is retained, the principle of deep-draining being still preferred.

The improved draining tools are in almost general use, and the narrow spade is much approved by workmen for taking out the bottom spit.

The cost of draining varies in the different parts of the county, according to the supply of and demand for labour, the facility of cutting, habits of living among the workmen, and other contingencies peculiar to the several districts. The common prices of cutting and filling the 3-feet drains, at the present time, are from 4½*d.* to 6½*d.* per rood of 7 yards; 4-feet, 7*d.* to 9½*d.*; 5-feet, 1*s.* 1*d.* to 1*s.* 3*d.*—varying according to circumstances. The higher prices apply more to the western division of the county, and the lower to the east, where the soil in general admits of more spade-work. The tiles are, in nearly all cases, placed by the day, and the acreable cost of the drainage varies from 3*l.* 10*s.* to 6*l.*, and more still in extraordinary or ill-managed cases.

The price charged for the 3-inch arch drain-tile, by which the prices of all the other sizes are adjusted, commenced in 1824 at 42*s.* per thousand, and has been gradually declining to about 26*s.* at the present period. The introduction of machinery in moulding tiles bids fair to reduce the price still further; and Mr. Rome, of Carlisle, has been so fortunate in his selection of an easy-working clay, and is so reasonable in his expectation of profits, that he now offers the same sized tile at 19*s.* per thousand.

In the vicinity of the roofing-slate quarries, and within moderate distances of the railways, where the cost of carriage is low, a considerable quantity of offal slates * are used for tile-soles. In other places wooden slabs are made use of; and where the sandstone is found in thin beds, it answers the purpose.

Pipe drain-tiles, with collars, are becoming more generally

* At some of the quarries the offal slates are cut into suitable forms and sizes, and are kept on sale for drain soles.

used every year, and are found both economical and serviceable; but hitherto they have had some prejudice to encounter.

Elkington's system of boring for water in the drains has been tried with good effect in some instances; but, speaking generally, the subsoil is of too clayey a nature, to a considerable depth, to derive great benefit from that operation.

Ventilating the drains on Mr. Hutchinson's plan, of conducting the pipes or tiles at the head of the drains out to the open air, thus giving increased action to the air and water in the drains by admitting a current at the head, has been partially adopted, with satisfactory results, so far as the trials have gone. But it must be evident to all who have had experience in draining, and studied it most, that *both theory and practice are yet defective*,* and we have still something to learn belonging to it. The greatest defect seems to be the want of *permanent* action. Thousands of acres have been drained on the various systems of the different periods; and though we have reasons to hope and believe that the deep drains of the present day approach nearer the standard of perfection than any of the former systems, it is difficult to find a single farm in the county so completely drained as not to require partial re-draining: some portion not acting so satisfactorily as to be pronounced perfect. It is notorious that a great extent has been drained a second, and some even a third time, and that a considerable portion of drained clays require some draining again. After the drains have run a few years in the heavy soils, they seem partly to abate in their action,† and some to cease altogether. The subsoil-plough, by stirring the strata immediately below the bed of the common plough, renews in some degree the action of the drains for a time. But the soil soon "sits down again," as it is termed, the clay cracks, and worm-holes cease to act, the land becomes stiff and cold, especially when in grass, and shows symptoms of excess of moisture, though the drainage may have been tolerably well executed and planned, according to the practice of the day. The clay soils of West Cumberland seem specially endowed with this quality, having less of the sand-veins and porous substrata in their composition than those of the principal part of the eastern division, where the under strata alternate in layers of clay and sand; and there draining acts more quickly, and with greater permanence and effect.

The extent of draining already performed may be tolerably estimated from the number of tiles manufactured within the

* It may be that ventilation of drains may effect the desired result. Clay land drained in that way in 1847 appears favourable so far.

† Some drains may be found which have acted for generations, and even sod and wood drains have been known to run well for 50 or 60 years.

county previous to the end of 1851. The number of tiles and pipes made, of all sizes, is 275,528,000, and reckoning twenty of these to the rood of 7 yards, and the drains at 7 yards asunder, the number is sufficient to have drained 140,000 acres. A great quantity of the land drained in the last five years has been done at greater distances than 7 yards, and, of course, fewer tiles have been put in to the acre. A few thousands of acres were drained with stone, sod, &c., but much of this has been re-drained with tiles, and nearly all require it. A part of the shallow tile-drains have been re-drained, and some portions twice, and a very considerable part of the residue is making some approach towards its original state, or at least, so as it must still be called wet rather than dry land. Taking all into account, there cannot be reckoned more than 120,000 acres of the inclosed lands in a properly drained state.

In 1793 the old inclosures were estimated* at	470,000	acres.
Improvable commons	150,000	,,
Lakes and waters	8,000	,,
Unimprovable wastes	342,000	,,
	970,000	,,

The commons inclosed previous to 1816, and after the above date, have been estimated at 200,000 acres ;† and since 1816 there may have been about 50,000 acres more inclosed, leaving the mountains and uninclosed commons at 242,000 acres, about 40,000 of which may still be held improvable by the application of modern enterprise to the skirts of the mountains.

The old and the recent enclosures will now amount to 720,000 acres, of which about 7 per cent., or 50,000 acres, is dry soil requiring no draining. Of the remaining 670,000, 120,000 having been tolerably drained, it will appear that there are still 550,000 acres, or something over two-thirds of the whole, which cannot be considered as producing all it is capable of, till properly drained.

The undulating surface and natural fall of the greater part of the county renders drainage of easier accomplishment than in level districts. The Abbey Holme contains the greatest extent of land on so low a level as to present engineering difficulties in the way of drainage ; and these are in a hopeful way of being overcome by the recent application of the landowners for Government assistance to erect machinery for lifting the water, when collected from the drains, into the sea. The country there is divided by parallel ridges, many of them some miles in length, in the direction of south-west and north-east.

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* Agricultural Survey. † Magna Britannia.

These ridges are elevated above the level of the intervening plots of moss land, from 2 feet to 30 or 40, and some to 60 feet or more, and vary in the composition of their soils from light sand to strong clay, including a considerable portion of excellent soil, producing, under the liberal farming of its present occupiers, abundant crops of all descriptions. Tiles are but of recent introduction there, and much draining is yet required. The levels, running "far as the eye can reach," were, till lately, dangerous "flowes," or shaking bogs, producing little but heath and peat, and tenanted only by red grouse and wild fowl, it being unsafe to put cattle on them. Considerable progress has been made in draining these, with the scanty fall permitted by the tide, which frequently dams up the drains, and causes great damage. Heavy crops of oats and sown grasses are raised on these partially reclaimed lands, by paring, burning, and liming, in the first instance; and afterwards by the application of clay or sand, as happens to be the most convenient. The Earl of Lonsdale has effected an extensive drainage on the neighbouring Bowness "flowe," which previously was not worth 6*d.* an acre.

By the energetic measures adopted, the land, which from time immemorial till 1848 was a trembling bog, now produces oats in such abundance as can hardly be credited by people who knew its original state, without witnessing the change.

Fortunately, the small farm of elevated land, called Rogersceugh, and belonging to his Lordship, is situated in a favourable position (being nearly in the centre of the moss land), and is composed of clay.

As the draining proceeded, and the surface became more firm, the heather was pulled and placed in diverging tracks, alongside of which a portable railway was laid in succession; and by means of horses, walking on the heather paths, clay from the farm was drawn along the railway and spread on the peaty surface, which was consolidated and improved, so as to bear the most abundant crops of oats.

The remainder of the Earl of Lonsdale's numerous farms are in progress of being drained on the deep-drain system, with pipes and collars; and interest charged at the rate of 5 per cent.

The Earl of Carlisle is rapidly effecting the drainage of his estate, many thousands of acres having been drained without charge to his tenants, beyond the labour of carting the pipes and collars. This labour is light, the pipes being manufactured at different places on the estate, and 1 inch pipes commonly used. On porous soils, 4 feet drains are put in at 15 yards asunder; and on clay soils, 3 feet drains at 12 yards apart. The clays all contain sand veins, more or less, otherwise the distances would be too great.

Henry Howard, Esq., of Greystoke Castle, Sir Wilfrid Lawson, of Brayton, Henry Curwen, Esq., Lieut.-General Wyndham, Sir R. H. Vane, and most other large proprietors resident in the county, are setting praiseworthy examples of extensive and improved draining; and indeed, few who have the means, or can obtain them, by Government grants or otherwise, omit draining to the extent of their ability.

At the rate draining is now proceeding, Cumberland must in a few years, with the blessing of Providence and the continued exertions of her cultivators, be capable of producing very much more from the land than has yet been witnessed. Whether the producers are to be remunerated for the unwonted competition of the present day, and of that which must follow, remains for a future period to develope.

VI. Whether Hill-side Irrigation has been tried, and to what extent it would be applicable.

Considerable pains have been bestowed in different parts of the county, to turn the streams to account in irrigating meadows, and much expense incurred in preparing them for that purpose. In some instances the benefit has been very great; and in a few others,—arising from defective under-drainage, or from misapplication of clay water to clay meadows, or of water which brings down and deposits a fine and poor sand, as is the case in some of the sandstone districts, disappointment has followed. One of the most successful experiments in this way was that of the late Rev. Mr. Matthews, of Wigton, whose meadows were judiciously laid out for watering, and, favoured by position, the sewerage of part of the town is applied with great advantage.

Most of the towns are placed in such low situations, that the sewerage cannot so well be applied without machinery, which has not yet been resorted to for that very desirable purpose. But two or three of them, which are better situated in that respect,* send the fatness of their streets and sewers into the nearest stream, with only feeble attempts to arrest their fertilising properties.

The irrigating† department of the county is at present in this anomalous position. A thinking farmer here and there may be seen carefully conducting his valued stream over every available portion of his meadow, fearlessly watching it during heavy rains, with spade in hand and drenched to the skin, leading it to places where his tiny dry-weather rill could not reach, and not suffering

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* Penrith, for instance.

† "The only attempt we (Bailey and Culley) saw of this species of improvement, that had the least resemblance to a watered meadow laid out by art, was at Bleatarn, about six miles east of Carlisle."

a drop to run to waste he can possibly prevent; whilst others, having abundance of rich water at command, heedlessly allow it to run out of their premises, without any attempt to turn it to a beneficial use. Many a muddy stream, the washings of limed or of manured or ploughed lands, is suffered to flow quietly away with the fruitfulness of acres in its highly coloured compound. Roadside ditches, impregnated with the finely pulverised limestone, of which many roads are made, and with the droppings of the horses and cattle passing along them, are too often suffered to stagnate, with evidence of their powers in the luxuriance of the weeds they produce. And above all, the "sypings"* of the dunghills and fold-yards (in spite of the thousand-and-one warnings of the agricultural writers of the day), in far too many instances continue to surfeit the small patches next their sources, without regret or restraint. It is true that some few collect and preserve all these means of fertilization, and apply them to good purposes. Some have formed pits below their dungheaps, as receptacles for the water which flows from them, into which they carefully collect the weeds of the farm, and the soil of headlands and ditch-sides; and those, after being saturated a few months with the essence of manure, form a rich compound for top-dressing. Others retain the black juices in ponds, until, with the aid of the water they may command, sufficient is collected to flow over the nearest meadow or grass field. Some have the liquid re-applied to the manure heap, to keep it moist; and all find the benefit of their several ways of application; but there still exists the great majority who shamefully neglect all these advantages; and no wonder if they run into arrear of rent, for such as they will commit other neglects.

It ought to be a special inquiry by a landlord as to whether an applicant for a farm has been in the habit of taking due care of his manure, and if he has not, to reject him at once.

The springs and streams which flow down the mountain-sides do not in general possess great fertilising properties; and therefore the "catch-water" system, so much approved in some of the continental husbandry, cannot be so universally practised here; and the sheep-farmers totally object to irrigation, as dangerous to the health of their flocks.

The tops of many of the mountains are covered with peaty soil, and from this cause the streams become impregnated with the water oozing from it, which contains a very considerable portion of tannin, and is hurtful to vegetation. There are springs issuing from the calcareous † beds of Crossfell, Hartside, and others of

* Provincialism for drainings.

† Some springs in the parish of Bolton deposit a strong crust of lime as they proceed, and are useless for irrigation.

the eastern range of mountains, extending to the northern limits of the county, which, if they could be cheaply kept separate from the peaty waters, would be useful in irrigating the dry inclosures on the hill-sides, but the cost would in many instances overbalance the profits; and the sheep stand in the way of irrigating the pastures on which they feed, for the rot would ensue to a certainty. The springs rising along the bases of the mountains, coming from the granite, clayslate, and metamorphic rocks, bring away only small portions of fruitful ingredients in solution. They issue from the rock as clear as crystal, and leave no sediment among the grass; but if they can be applied, for short intervals in the winter months, to meadows at a little distance from whence they arise, and while they retain the higher degree of temperature they bring from the bowels of the earth, the effect is usually good. Their natural warmth has its effect on the soil and herbage, and is instrumental in bringing to life the countless myriads of animalcula which the microscope reveals to our senses.

Professor Johnston* attributes the enriching properties of irrigation "to the removal of noxious substances from the soil, the addition of enriching food, saline, organic, or gaseous;" and there are few of our streams (those from peat excepted) which do not convey some portion of either mineral, animal, or vegetable ingredients to the soil, and rarely in such quantity as to be hurtful.

The writer has been at some pains to try the effect of lime slaked in the main cut of a water-meadow, and floated in that way over the surface. The water was of a peaty nature, with a small portion arising from springs and drains in clayey pasture-ground, and the meadow to which it was applied is clayey also, and drained. No improvement followed; but it must be admitted that an experiment on a purely dry soil, which the farm does not contain, might have been attended with a better result.

It is not often that manures, not strictly chemical, are applied to meadows in the winter or spring months, experience having pointed to the season immediately after the hay is cleared, as the manure is then laid in closer contact with the surface, and is then quickly covered with the rising vegetation, if the season be not droughty.

Bailey and Culley say, "The largest tract of natural meadow, in this county, is in the parish of Scaleby." This tract now extends to upwards of 1000 acres, and has been much improved within the last twenty years. About the year 1830 a bond was entered into by the parties occupying lands to be improved by the deepening of Brunstock Beck, which drains the Scaleby meadows. The improvement has been greater, and extended

* Elements of Agric. Chem. and Geology, p. 258, &c.

further, than the parties anticipated; and on a recent renewal of the contract for the annual cleansing of the beck, the smaller proprietors, farming their own estates, objected to join, on the ground of others enjoying so much of the benefit. The matter was put to the vote, and the number of spirited tenant occupiers completely outvoted the owners, and continued the bond with its useful conditions.

The county, as compared with most others, enjoys its full proportion of meadow land; but the average quality of the meadow soil (perhaps its management, and certainly the quality of the hay) is below the average.

Hay.—A large proportion of the smaller farms, such as those of the mountain vales, and along the western bases of the fells, and those of the lower districts of the county, not exclusively wheat-growing farms or on clay soils, are in a great measure dependent on their meadow lands for the winter support of their cattle; and when a wet hay harvest occurs, which is not unfrequently the case in this county, the crops of meadow hay are so injured by long exposure to the weather, and by the mud and sand left by the overflowing of the streams, that the hay is of little value as fodder, and the cattle suffer accordingly. Many meadows, which are occasionally overflowed, produce hay having a sickly or fishy scent, and this the cattle do not relish or thrive on. The coarser meadows also, which throw up much of the *Juncus acutiflorus* and *J. lampocarpus* (provincially termed "closs"), intermixed with other grasses of poor quality, are noted, in homely phrase, as producing "lousy hay,"—that is, hay on which cattle deteriorate in condition, consequently the pores of the skin close, and vermin soon establish their countless swarms on the poor starved animals. The remedy for this is draining. The fishy flavour * is not so easy to remove, as it is known to remain long after the floods are embanked out of the meadows in which it has occurred. Meadow hay very readily acquires a disagreeable taint, if placed in contact with offensive animal matter, so that much care and attention should be given to retain its delicate aroma.

From the backward springs so frequently occurring, and the consequent want of early grass, for the pasturage of cattle when the fodder is consumed, the meadows are often grazed to a later period than they ought to be. Where mountain sheep are kept, it is not unusual to find part of the flock in the meadows till nearly the end of May; and where sheep do not require such an indulgence, it frequently happens that the milch-cows do; and instead of the meadows being freed from the period when the

* This may be partly corrected by the application of salt in storing the hay.

grass commences to grow, they are depastured till nearly the time when the forward meadows ought to be cut.*

It would seem almost in vain to struggle with the customary rains of July on the western or "wet side" of England in haymaking, with a fall of rain in that month, amounting, in most years, to more than falls in the other summer months; and unless the meadows are better drained, managed and manured, and shut up much earlier, and every other facility given to their early growth, it is in vain, in ordinary years, to attempt the meadow haymaking so early as June; but when an early season does occur, every hand that can be spared from the turnip work should be put to the hay, to have it quickly secured, as the quality of early and quickly-made hay usually compensates for the deficiency in quantity, and the fog or after-growth is much heavier as well as better.

Very little meadow grass is cut a second time in the same year. It is only on the better class of meadows that fog can be grown in any quantity. On many of the inferior meadows cut about August, the fog is not worth half-a-crown an acre, and the marks of the scythe may be discerned on them till the following spring.

The greater part of the meadow hay is made in August, which month usually averages less rain than falls in July. Until some cheap and effective method, in these days of invention, is discovered of drying crops by artificial means, the Cumberland farmer must content himself with "making hay when the sun shines," whether the month be June, July, or August.

The Cumberland farmer cannot claim any credit for his superior system of haymaking. His main object is to secure it dry enough for keeping, with as little labour as can possibly be given to it; and his anxiety to get it, in our precarious climate, is so great that he is often compelled to overlook the important object of obtaining quality in order to be able to secure it at all.† It happens that the district having most meadow-land is generally most thinly inhabited; and so many of the hay-farms being at a distance of 6, 8, and 10 miles or more, from towns and villages having labour of this kind to dispose of, and the uncertainty of the weather continuing fine if help were brought, coupled with the froward assurance and unskilfulness of many of the town labourers, which the retired demeanour of most country people

* Plants, as well as animals, are the creatures of habit, though in a lesser degree; and when the meadow-grasses are constantly retarded from perfecting their seeds beyond the period ordained by nature, it is reasonable to infer that, when the cause is extended over a succession of generations, the effect is likely to be a slowly-acquired but confirmed habit of not attaining maturity till a later period of the season. This is a proved fact in horticulture.

† The writer recollects the season of 1816, when a range of meadow-land, in which he was engaged, was flooded three times before the crop was cut, and fourteen or fifteen after, in the months of July and August. Of course the crop was useless, and little hay was tolerably got in that year.

renders them unable to cope with, places the occupiers of those farms in a disadvantageous position as to the security of the crop on which their greatest dependence rests.

Few of those farm-houses can accommodate extra hands, as boarders, in the hay season; and if they could, the want of employment on gloomy or rainy days, which usually occur, allows no alternative but to obtain the utmost possible exertion of the hands belonging to the farm or immediate neighbourhood, when the weather permits. Near towns and villages, where more hands are obtainable at ordinary wages, there is seldom a sufficient excuse for the defective manner in which the hay is too generally secured. It is rare indeed that hay is turned oftener than once in the day. On the appearance of settled weather, the great anxiety is first to get the grass cut: it is then spread out of "swathe," and put into foot-cock. Next day, if other work does not press, it is shaken out, turned once, and put into larger cock, where some let it remain two or three days, while other portions are got into the like state. It is then broke out for carrying, after being turned, if thought needful; or sometimes carted out of cock, if very dry when put up. Others let the hay rest in foot-cock, or even in swathe; and if the weather is hot, the upper surface roasts and the under side turns yellow, and both spoil; too often the work becomes confused, from not knowing which stands in greatest need of doing first; the crop is injured, and great loss is the consequence. The loss is still greater in bad weather; and no rule can then be prescribed for working the hay, but to get it dried and secured as speedily as possible.

In parts of the kingdom where the value of well-got hay is duly appreciated, and the hay season less liable to interruption from bad weather, hands are provided sufficient to stir the newly-cut grass at short intervals till it is fit for the house or stack, and care is taken to neither underdo nor overdo it in drying, as far as the weather will permit. It is to be hoped the greater value of hay secured in this way will induce the farmers of this county to adopt the system;* but it must be a work of some time.

Mr. Grainger, of the Abbey Holme, in his address to the Carlisle District Farmers' Club, in July 1851, says, "The grass should be cut as soon as the first flowers blow, for at that period it contains all the useful qualities of which it is susceptible, and

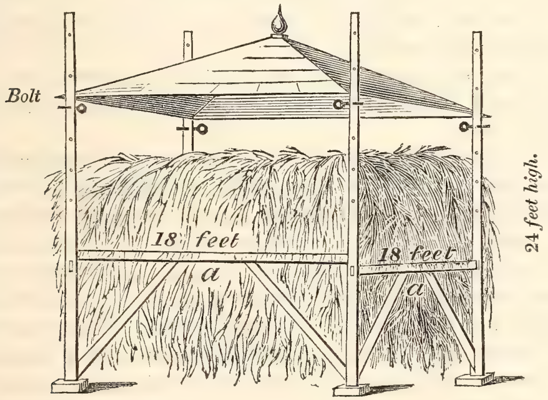
* Mr. Benn, when steward to the Earl of Lonsdale, at Whitehaven, had on an average of years 440 acres of meadow and 70 of ley hay under his charge. He availed himself largely of town labour, and managed his heavy crops well. Also Mr. Turner, of Moresby Hall, if the weather is fine, has the grass put into oot-cock on the same day it is cut twice, or occasionally three times, if he has sufficient hands, always shaking out the swathes and cocks by hand, and never leaving it out of cock in the night. It is frequently fit to house or stack on the third day. His farm is close to the sea, and near to labour, *ad libitum*, of which he judiciously avails himself.

afterwards becomes daily more tough and sapless." . . . . "Grass should never remain spread over night if possible, as both capillary attraction and dew will injure it." He also very properly "objects to large cocks as well as tramped pikes, on the principle of aiming at one fermentation only." And "When the weather has continued long unfavourable haycocks should be placed on fresh ground, first taking off the top entire, turning and shaking the remainder, and next replacing the top."

Less difficulty is experienced in making hay near the shore, where the fall of rain is so much less than among the mountains.*

Several yeomen and gentlemen farming their own estates have hay-barns on the Dutch system of slate roofs on stone pillars.† Some are open on both sides, with closed ends; and others are closed on one side, and on one or both ends. Mr. Grainger estimates the cost of this kind of barn, open on one side and one end, at 12*l.* per length of 10 feet, with 21 feet in width, and 15 feet high; to hold 140 cubic yards.

A less substantial, but less expensive and equally useful kind of hay-barn has been adopted by a few in West Cumberland.‡



This consists of a sheet-iron roof on a slight deal frame, which slides up or down on larch poles. The rafters of the framing are placed at distances to fit the size of the sheets of iron, and these have one or two coats of paint or gas-tar before being fixed on the roof. The nails used are first heated to a dull red, and, while hot, are soaked in linseed oil to prevent rust, and are driven

* Bailey and Culley say of Cumberland hay-growers:—"We do not find anything particularly excellent in their practice; the only singularity is that the occupiers of small farms put the whole of their hay into barns; the larger farmers stack theirs at their doors." The small farmers have room for their crops at the present day.

† Dutch barns, being open on one or both sides, admit snow and rain, and suffer the hay to be blown out, when not entirely full.

‡ And in Alston also, in the Eastern division.

through the overlap of both sheets at a time, so that they exactly fit the nail-holes, and do not admit rain. The cost of this cover, on larch pillars let into stone pedestals, to contain 270 cubic yards, has been ten guineas. The present mode of lifting or lowering the roof is by pulleys at the corners, or by a ladder applied at the corners in succession.

The great advantage of this cover is the safety it gives to the hay under it at all times, whether it contains a great or a small quantity. The roof is easily secured at any elevation, so as to admit a current of air to pass over the hay, and carry away the moisture arising from fermentation, or lowered to keep out rain or snow. When the hay is in the act of first settling down, it is apt to rest a little on the cross-beams connecting the pillars, and then has a tendency to reverse the layering of the hay immediately below the beams, and to admit a little rain. A trifle of thatch (at *a* on the sketch) on the exposed (south or west) side, has been all the extra protection hitherto found necessary on that account.*

The saving of hay, by either of these methods, over that of stacking in the ordinary way, is so great, taking into account the loss occasioned by precarious seasons, that few who have experienced the benefit would now be without them; and the wonder is that so few are erected.

The piking of hay is very properly little resorted to in Cumberland, except in cases of emergency, and by those who do not calculate the loss.

It is of some importance to the farmer to attend well to the way in which his hay is consumed. Few take the trouble to calculate or think of the difference in the quantity consumed by the same number of cattle, of hay pulled from the side of the "mow," and of that recently housed from the cutting of a stack, or carelessly tumbled from the top of a mow. It cannot be that cattle relish and eat more of the newly housed hay, than of that which is newly pulled from the solid mow; for it is a fact that much of the aromatic flavour soon leaves it on exposure to the air. But it is well known and admitted on all hands that cattle consume, or go through, with ordinary feeders, very much more of the recently disturbed hay than they do of that not disturbed till it is wanted and pulled for immediate use; and that 20 or 25 per cent. in the quantity may be saved, with as good an effect, in hay pulled from the mow when wanted, over hay of the like quality tumbled loosely down into the hay-barn from the stack.

Part of the loss may be attributed to the waste caused by the removal; for hay cannot be removed in the winter season, in any way, without waste; but the greater part may be accounted for by the fact that *what is easily got is readily given.* The cattle

* Eight years since two were erected on one farm, and another six years ago; and the expense of repairing has only been two or three coats of coal-tar each.

feeders are more careful of the hay they are at the trouble of pulling from a hard mow, than of what is brought into them ready for lifting and placing before the cattle; and hitherto the practice of feeding by weight has not come into use, as it easily might if the hay were cut into four-inch chaff. On most of the small farms where the cattle are attended by members of the family, the pulling of hay is strictly and properly attended to. But on larger farms, where cattle are of necessity committed to the care of hirelings, under the master's eye only when his other avocations permit, and the hay brought in by the cart-load during the season of feeding, the waste is often very great. But it is when the hay is lifted in flakes and layers from the top of the mow, that the greatest waste is committed; for it is commonly imperfectly shaken to separate the stems; and when given in that form, cattle only eat what is loose, and the rest goes for litter. Where the consumption is great, the wages of a lad or woman to pull the hay would soon be saved.

Not much of the clover crop is cut a second time. It is commonly eaten off with sheep or cattle; and is too often suffered to stand till it flowers before being eaten. There is then considerable waste of crop, and consequent exhaustion of the soil.

VII. Improvements made since the Report of J. Bailey and G. Culley in 1805, and to what extent still required.

Most of the improvements which have taken place since 1805 are of a similar character with those of other counties, and are generally mentioned under their respective heads in the course of this essay.

The embankment of 250 acres of Millom Marsh by the late Earl of Lonsdale is a substantial improvement, and might be successfully imitated in the neighbourhood of Burgh* and Rockliff† to a still greater extent.

Railroads are certainly improvements of no common order; but these, running as they do so far along the shore, do not benefit the agriculturists of the interior parts of the county as they would do if carried more inland.

Tile draining is new, and turnip husbandry with winter feeding of cattle and sheep much extended and improved since 1805, and both are still progressing.

Iron implements, the application of steam-power, and thrashing-machines, are in a great measure new; and it may again be noticed that water-power might be much more employed than it is.

Roads, both public and private, are very much improved, and

* Pronounced "Bruff."

† The shifting of the boundaries of these marshes by the floods and tides has lately been to such an extent as to require re-adjustment of the rights of pasturage, and amounts to 200 acres or more.

probably require less improvement now than any other department connected with agriculture.

Public drainages seem required in some parts; as in the Abbey Holme, at the heads of Bassenthwaite and Derwent lakes, &c.

Short-horn cattle and the crossing of mountain sheep have been introduced within the present century. These are capable of still further improvement; but attention is keenly fixed on them, and is likely to further develope their capabilities.

Many of the inclosures of commons with their reclamation have occurred within present memory.

In short, every branch of agriculture is very much improved since the date mentioned, and there are few branches but what are likely to be still further improved. The education and habits of the people have felt the influence of improvement greatly; and if anything requires attention more than another, it is such an education of the youth of the labouring classes as may better fit them for the duties of servitude.

The extent of draining required is adverted to in another place. With its extension, the dead fallows will no doubt be supplanted by green crops.

The growth of lucerne on the deep dry soils, and of Italian rye grass on other soils, will be found of great advantage in soiling cattle, &c.

Great improvements may be made, and much land gained, by exchanges of intermixed lands, and removal of old and crooked fences.

Cutting hay and straw into chaff for the use of cattle and horses ought to be increased till the whole produce of the farm can be consumed by them, instead of so much being used for litter. This saving of fodder, and the avoidance of the waste committed in the slovenly system of foddering out-lying cattle, would amount to something considerable.

Assuming that no competent person would trouble himself to obtain legislative interference for the extermination of thistles, the power of ridicule ought to be resorted to for compelling indolent men to attempt the eradication of this weed—the charge of the road sides being vested in the parish officers, by way of setting example. Docks are more manageable weeds.

An organised determination ought to be formed to compel the vagrant hordes who encamp on the road-sides and bye-lanes to abandon their predatory course of life, and adopt some more honest calling.

Other requirements are noticed in the body of this report.

W. Dickinson.

North Mosses, Cockermouth.

XIV.—*Report on the Exhibition and Trial of Implements at the Lewes Meeting*, 1852. By H. S. Thompson.

CONTENTS.

The Exhibition of Implements at Lewes would probably be very differently described by different classes of visitors. Casual observers would report that the encampment of the Royal Agricultural Society in 1852 displayed about the average amount of red and blue paint, and that there was the usual number of complicated, unwieldy machines, which, if good for nothing else, served, at any rate, thoroughly to puzzle the uninitiated. Even the majority of farmers would probably think that the ploughs and the drills, the steam-engines and the threshing-machines, *cum multis aliis*, differed little from the very similar-looking implements they had been accustomed to see at the Society's exhibitions, and would be not unlikely to remark to one another "that it was a good show, but that they had seen it all before." If this were so, the brains of a number of ingenious men would have been racked for many months to lamentably little purpose; but, fortunately, those whose province it was critically to examine the various implements composing this exhibition are able to give a more satisfactory account of what they saw, and their description of the Show at Lewes might be briefly but emphatically expressed by the one word—*Progress*—steady, satisfactory progress, which was observable in nearly all classes of implements, from the costly steam-engine down to the three-and-sixpenny digging fork. The details of this progressive improvement will be found in the Judges' Reports; a few of the leading points only will be selected as the subjects of the following remarks:—

The greatest novelty in the Society's Show-yard was the class of reaping-machines, which excited the most lively interest, especially amongst the very considerable assemblage who saw them at work. The trials of last year had thoroughly roused the curiosity of the public, and shown the feasibility of reaping by machine; whilst the decisions that were arrived at in different parts of the country were sufficiently conflicting to leave the great contest between M'Cormick and Hussey still an open question. On this occasion the palm of superiority was awarded to Messrs. Garrett's machine, on the Hussey principle, which did its work with remarkable precision. Several other machines were tried, varying more or less in the details of their construction, but the real contest lay between the Hussey and M'Cormick principles. Mr. Amos, the consulting engineer, has pointed out in his report, that at this trial the weather was remarkably dry and hot; and though the corn to be cut was rather green, it was quite dry, and stood perfectly upright, so that the greatest impediments to cutting by machine were not encountered on this occasion, and subsequent trials have shown that the absence of moisture was favourable to machines on the Hussey

principle. Judges, however, can only deal with circumstances as they find them, and the work was undoubtedly better performed by Garrett's (Hussey) than by any other of the competing machines. The only drawback to the goodness of its performance on this occasion was the pace at which the horses were required to walk, and its heavy draught. Crosskill's on the Hussey, and Samuelson's on the M'Cormick principle, also worked very well, but the first-mentioned machine was clearly entitled to, and received the prize.

Numerous trials of reaping-machines have since taken place, the most important of which have been—

1. At the Agricultural College, Cirencester, lasting for several days, during which upwards of 100 acres of various grain crops were cut. The official account of this very careful and impartial comparison of the rival machines is published in the Appendix to this Report (see A), and gives the preference, in some important particulars, to M'Cormick's machine; but concludes by stating that each of those tried (viz. Garrett's Hussey, and Burgess's M'Cormick) is capable, even "in its present state, of doing much service to the farmer, but that both are susceptible of very great improvement."

2. At the meeting of the Yorkshire Agricultural Society at Sheffield, August 2nd, 1852, where M'Cormick's machine received the prize. The report of this meeting is not yet published, but will appear in the forthcoming number of the 'Transactions of the Yorkshire Agricultural Society.'

3. At Driffield, August 17th, under the management of the Driffield Farmers' Club, in which M'Cormick's machine was a decided winner. (For Report of this trial see Appendix B.)

4. At the meeting of the Cleveland Agricultural Society at Guisboro', August 26th, 1852, at which the verdict of the jury was in favour of Garrett's Hussey. (For Report see Appendix C.)

5. At the Perth meeting of the Highland Agricultural Society of Scotland, August 6th, 1852, at which "Bell's reaper" was considered superior to a Hussey manufactured by Crosskill. (For Report see 'Transactions of Highland Society,' October, 1852.)

Such opposite conclusions, arrived at by men selected as judges for their known talent and practical skill, can only be accounted for by the varying circumstances of crop and weather under which the trials took place, which produced a marked difference in the performances of the same machines on different occasions. The trials of 1852 have not, therefore, concluded the controversy between the rival reapers, or established that any one principle of construction is decidedly superior to others; but in the course of the season a mass of practical evidence on the

subject has been obtained which may be turned to good account both by agriculturists and implement-makers. With this object in view the writer put himself into communication with farmers in different parts of the country, who had used reaping-machines during the harvest of 1852, and has now before him the written opinions of a considerable number of practical men, who give their own experience of the use of these implements. In the present position of the labour-market the production of a really effective reaping-machine is an object of national importance ; so that it will scarcely be necessary to apologize for devoting a few pages to the result of these inquiries.

Before commencing, it will be proper to allude briefly to the circumstances under which these machines have been brought prominently before the public. The Highland Society's Journal for January 1852 contains an elaborate paper by Mr. Slight, giving a detailed description of a number of reaping-machines which have been brought out in Great Britain since the commencement of the present century, and a pamphlet, printed in the United States,* describes a number of different machines, both British and American, and even alludes to an ancient one used in Gaul, which is described by Pliny and Palladius, (?) the latter of whom states that one of these machines, worked by one ox, cut large fields of grain in a day. Those who are desirous of tracing the successive inventions that have preceded and paved the way for the adoption of the present forms of this machine, will do well to consult the articles referred to, especially the one by Mr. Slight, which is very carefully written. For our present purpose it is sufficient to mention that the information thus studiously collected conclusively proves that none of the reaping-machines of the present day can claim to be considered the "*original reaping-machine*," though each of them (Bell's more especially) bears the stamp of original talent.

After the first production of the reaping-machine, the next point which claims our attention is the lateness of its introduction into British agriculture. It is a remarkable fact that, though reaping-machines have been largely used in America for some years past, and though even in Great Britain Bell's reaper has worked year after year for nearly a quarter of a century to the entire satisfaction of its owners, yet that very few British farmers knew or cared that such a machine was in existence until the opening of the Great Exhibition, when this friendly comparison of the products of the world's industry showed British farmers that in this point (at least) their American brethren were fast

* 'Remonstrance (to the Congress of the United States) of the Citizens of New York against the renewal of Letters Patent granted to Cyrus H. M'Cormick, June 21, 1834, for Improvements in the Reaping-machine.'

going ahead of them. Mr. Slight, in his article alluded to above, attributes the tardy adoption of reaping-machines in Great Britain to the want of furrow-draining, and the consequent prevalence of high ridges, with their intervening deep furrows. Such a state of the land would undoubtedly increase the difficulty of working them, but they have spread rapidly in America, where obstacles arising from irregularities of surface are much more formidable than with us, and there are large tracts of dry level land in England where no physical impediment of this kind exists. Some other causes must, therefore, be found, and the writer is disposed to think that the principal ones are—the costliness of the British machines previous to 1851;—the ignorance of farm-servants of the proper management of even the simplest machinery;—and the cheapness of labour in England when compared with the United States.

So long as ploughs and harrows constituted the staple of farm implements, the price of Bell's reaper (35*l.* to 45*l.*) would appear a startling outlay for the purchase of a machine that was not strictly indispensable, especially when it would have been necessary to engage a mechanic to take charge of it. The general introduction, however, of drills, threshing-machines, and even steam-engines, must have materially altered farmers' views both of the cost and the difficulties of management of a reaping-machine, particularly when the price demanded for it was reduced to 18*l.* or 20*l.*; and now that the increasing value of labour in Great Britain has given an additional inducement to agriculturists to seek mechanical assistance, it may be safely said that the day of reaping by machinery is fully come. A strong corroborative proof of this assertion is to be found in the fact, that, though the American reapers exhibited last year were confessedly imperfect, and required considerable modification to satisfy the requirements of British agriculture, yet, within the short space of 12 months from their first trial in this country, more than 1400 had been ordered of four of the leading makers, involving an outlay exceeding 30,000*l.*

It is true that many of those who purchased a reaping-machine for use last harvest found it rather a hindrance than an advantage, and threw it aside in disgust; but it must not be forgotten that, in addition to the ordinary difficulties attendant on the introduction of a machine with which the master is not familiar, and which the men devoutly wish may prove a failure, there were in the harvest of 1852 difficulties peculiar to the season—difficulties arising from the state of the crops, the state of the land, and the state of the weather, such as have not been encountered for many a year, and which may reasonably be expected not soon to happen again. In America reaping-machines are fast

coming into general use, in spite of impediments which might well be considered insuperable, and of which some idea may be formed from the following brief quotation from the Report of the Committee appointed to superintend the Trial of Implements, at the meeting of the New York State Agricultural Society in July, 1852. One of the fields selected for the trial of reaping-machines is described as follows:—"The barley-field, containing about 30 acres, was more uneven as to its surface—deep irregular water-courses traversed its length, the water standing in some portions—many boulders and stumps were in the track of the machines—the grain was much lodged and tangled—the straw soft and tough." The Report subsequently states that such a *combination of difficulties* can rarely occur, but the machines were evidently expected to be capable of dealing with such impediments, and, even under these circumstances, the work appears on the whole to have been well done. At the same meeting a trial of grass-mowing machines took place, at which the performance of the two prize machines is thus described:—"The quality of the work accomplished by both machines could not fail to satisfy any farmers, and was better done than could be performed by the most expert mower with a scythe." Such facts as these appear fully to justify the assumption that the reaping-machine has now established its claim to be promoted from the militia or auxiliaries, and to take rank among the regular forces of the great agricultural array.

A summary will now be given of the opinions entertained of the M'Cormick and Hussey reapers by practical men who have used them during the last harvest. Their principles of construction will also be examined and compared with that of Bell's machine; but it should be premised that, in consequence of the much larger number of the Hussey machines that have been sold, than of any other form of reaper, they have been worked under a greater variety of circumstances, and a proportionately better opportunity afforded of discovering any defects or drawbacks to their use in particular states of the soil, crop, or weather. Hence it follows that the evidence in possession of the reporter relating to the M'Cormick machines is much more limited than that respecting the other, though even in this instance he has, in addition to his own observation and inquiries, the written opinions of at least a dozen practical men to refer to who have had more or less experience of the use of this reaper on their own farms. His acquaintance with Bell's machine is chiefly confined to the reports of the public trials that have taken place, and to a few lines from Mr. Bell, brother of the inventor, whose experience of its use for above twenty years is, of course, exceedingly valuable. The testimonials are,

on the whole, so numerous, that it would be out of the question to refer to them individually, and the course that will be adopted is to mention all the difficulties that have been met with, and then consider to what extent they are removable, and how far they are inseparable from the peculiar construction of the respective machines. To commence with those on the Hussey principle:—The complaints expressed are—

1st. The clogging of the knives, leading to stoppage, or even breakage, when the crop is heavy or the straw damp, particularly when cutting barley, or when there is much couch or young clover among the corn.

2nd. The great pace at which the horses are obliged to walk, especially under any of the circumstances named under the first head.

3rd. The heavy draught, requiring three horses.

4th. The weight of the pole, which presses unduly on the horses' necks, eventually making them tender.

5th. The difficulty of delivery where the crop is heavy.

Of these objections the *fourth* has been entirely obviated by the adoption of curricle gear in Mr. Garrett's machines, and shafts in lieu of pole by other makers; and the *fifth* has been materially reduced by the introduction of what is called the roller-platform,* whereby the man's labour in putting off the corn is much lightened. Every one knows the difference between dragging and rolling a weight along the ground, and will therefore readily believe that the introduction of rollers to aid in the delivery of the corn is a material improvement.

The first, second, and third objections are inseparably connected with the cutting principle of these machines, which has been so often explained in print, that it will be sufficient to mention here that the cutting part consists of wedge-shaped knives which vibrate rapidly between metal guards or, as they are termed in America, fingers. The angle at which the cutting-knife meets the fixed edge is a very acute one, so that, though it has the advantage to some extent of a drawing cut, it yet meets its work so directly as to require a sharp edge to sever any thickness of straw or other tough substance. The splashing of rain causes the lower parts of the stalks of all plants to have more or less soil adhering to them, which quickly takes off the keenness of knives cutting near the ground, and consequently no continuous action of these machines could be maintained if it were necessary to keep the knives so sharp as to cut with any effect when vibrating at a moderate pace. To atone for the want of sharpness it is requisite that the knives should move with great rapidity, and

* The idea of the roller-platform originated with Mr. Palmer of Stockton-on-Tees, whose highly intelligent suggestions have led to this and other improvements in the reaping machine.

the gear for getting up this speed inevitably produces heavy draught. Where the crop is light, or where a good crop is ripe and dry, the Hussey cutter goes cleverly through the crisp straw and makes beautiful work; but when the straw is tough and moist, the knives, when a little dulled, cannot clear themselves. Mr. Pusey has found that the Hussey machine does not work well in a wind, which is to be explained on the same principle as the other causes of stoppage already named, viz. that the cutters, constructed on this principle, *must be kept clear*. In some cases this is prevented by damp, which causes short straws, grass, &c., to hang about the knives; in others by wind, which blows loose straws back on the cutters, or it may arise simply from the weight of the crop, which makes the raker unable to draw away the corn as fast as it is cut; but whatever be the cause the effect is the same, viz., that the machine clogs, and requires clearing. It must also be backed before it can recommence cutting. From the natural dislike, however, of both master and men to frequent stoppages, the horses are often pushed on to increase still further the speed of the knives, until they either force their way through all obstacles, or a breakage takes place. The M'Cormick cutting principle is free from this material objection, and is decidedly improved since last year. In the report of the implements shown in the Great Exhibition, published in the Royal Agricultural Society's Journal for 1851, it was pointed out that M'Cormick's machine had a straight-edged cutter which had a tendency to press down and pass over the corn instead of cutting it, unless it stood perfectly upright or leaned towards the machine. This was considerably aggravated by its not cutting near enough to the ground. In the M'Cormick reapers which have come under the reporter's notice this year, the straight cutter has been replaced by one with a scolloped edge, and the machines are also set lower; hence a material improvement is observable in their action: indeed the cutting principle leaves little to be desired. The straight cutter, originally used by M'Cormick, was entirely dependent on its sickle edge, which enabled it to saw through the straw, but the scolloped-edged cutter now introduced consists in fact of a series of knives, differing from Hussey's in the very different angle at which they work, as well as in having a sickle-edge. It has been before shown that the Hussey cutters meet the fixed edges of the guards against which they cut at so very acute an angle that they are liable to choke. The M'Cormick knives work at a much greater angle of inclination,* so much so, that they would push

* The difference in the acuteness of this angle in the two reapers will be at once perceived on comparing the dimensions of the knives, which, though varying somewhat in the machines made by different firms, will be found to average about 3 in. × 3 in Hussey's, and $\frac{5}{8}$ in. × 5 in M'Cormick's.

the corn forward instead of cutting it, were it not for their serrated edges, the teeth of which are so shaped as to retain good hold of whatever is presented to them. Hence these cutters work well at a moderate rate of vibration; and the additional gear required to get up a high speed being unnecessary, the draught is proportionably easier. In Bell's machine the cutting knives consist of shears formed by a certain number of fixed blades, between every two of which a moveable one vibrates, cutting both ways. From the length of cut of these blades (12 inches) it is not necessary that they should vibrate rapidly; and when the adjustment of the knives is sufficiently good to enable them to cut without missing any straws, the work is satisfactorily done.

The objections to the M'Cormick reapers are—

1st. Difficulty of delivery when the crop is heavy.

2nd. Form of the sheaves or bundles, which are not thrown off in as good a state for binding as those from the machines which deliver behind.

3rd. Too great width for ordinary field-gates.

4th. High price.

Where the crop is heavy it is difficult for the raker to deliver it fast enough to prevent the sheaves being too large. This objection, as well as the 3rd, and to some extent the 4th, would be obviated by making the machines of rather less width; and the writer is disposed to think that the work would proceed with greater regularity and steadiness, and therefore in the long run with as much rapidity, if this suggestion were adopted. Even at their present width, however, it is difficult to see why they should cost 30 or 40 per cent. more than those on the Hussey principle, and it is hoped that the system of small profits and quick returns will find more favour with the makers of these machines than it has hitherto done. The objection to the form of the sheaf is one which it would not be easy to remove, as in a side delivery the bundle of cut corn receives somewhat of a swing or twist, which prevents its lying so straight as when pushed off behind just as it falls on the platform. The question, which is the best mode of delivery, is a material one. The method adopted by Hussey makes it necessary that the corn should be immediately bound up, so that the reaper cannot be used till the dew is off, and might frequently be idle for some hours in a day. It is also open to the no less serious objection, that when any stoppage occurs to the machine the whole force of the harvest-field is brought to a stand. The side delivery of M'Cormick's, though free from the objection just named, is by no means all that could be wished. If corn is cut with the dew on, it would be decidedly prejudicial to leave it in bundles, and equally so in the case of oats or barley intended to remain for a day or two unbound. Lastly, it is clear that any mode of manual delivery, however good in itself, must

fall short of the regularity of mechanical action, so that on the whole the endless web adopted in Bell's machine is apparently the best in point of principle that has yet been produced. It is described as having worked at the public trials in Scotland with remarkable precision, leaving so regular a swathe that the sheaves, when bound up, resembled those gathered after the sickle, and the stubble required no raking. A more extended experience of this mode of delivery must determine whether there is any practical impediment to the uniform action of the endless web which diminishes its apparent superiority over the more rough and ready method adopted in the American machines.*

From the foregoing facts and considerations the following deductions may be drawn:—

1st. That the Hussey machines, with the latest improvements, are cheap handy implements, which will be found to work well if used only when corn is dry and where it has little undergrowth of clover, so that it may be bound up at once without injury. With such limitations, however, it is evident that the partial use of the scythe must form part of the harvest arrangements.

2nd. That the cutting principle now adopted in the M'Cormick machines is simple and efficient, and, if well manufactured, not liable to be stopped by any ordinary difficulties arising from the state of the crops or the weather.

3rd. That the mode of delivery adopted in Bell's reaper is the best in principle, and this machine has also the advantages of being able to cut its way into a crop, and of laying the swathe to either side. Further experience must decide whether these advantages are sufficient to counterbalance the somewhat greater difficulty of steerage and the awkwardness in turning which appear to be unavoidable when the propelling power is placed behind the machine. The greater cost will also be a material consideration when comparing this machine with others.

Finally, it may be stated that, though none of the reapers can yet be considered completely satisfactory, the experience gained during the past season will doubtless enable the manufacturers to turn out serviceable machines calculated to render real assistance to the farmer; and after a long and patient examination of the performances of this class of implements, the writer is convinced that no long time will elapse before the great bulk of both corn and hay crops in this country will be cut by machine.

The next class of implements deserving of especial notice is

* Mr. J. S. Wright has lately brought over from America a working model of a highly ingenious piece of mechanism applicable to reaping machines, which is termed by the owner "the automaton raker." As a mechanical invention it deserves great praise for the ease and precision with which it executes a difficult movement. It would be as yet premature to offer any opinion as to its practical merits.

that of Thrashing-machines; and as the writer has thought it necessary in previous reports to point out what seemed to him serious defects in those exhibited even by the best makers, it would be unjust to them if he were not equally ready to remark upon the great improvement which has been made in the last two years. The tabular statements furnished by the judges give the details of their performances; it will therefore be sufficient to state here that, until this year, the thrashing-machines exhibited have never come up to the writer's ideas of what a thrashing-machine ought to be, but that those exhibited at this meeting by two or three of the leading makers were, in his opinion, good, sterling implements, which might be safely purchased. A decided step in advance has been made by Messrs. Clayton in the machine which was recommended by the judges and stewards for the Society's gold medal. It not only did its work well, as shown by the record of the trials, but is calculated to meet one of the most pressing wants of the present day by effecting an important saving of manual labour.

In the drill department the great rival makers have entered upon a new line of competition, which cannot fail to benefit their customers, and which it may be pretty safely predicted will ultimately be equally beneficial to themselves. Messrs. Garrett and Hornsby are both turning their attention to *cheap* drills. Four years ago the writer's remarks in favour of reduction in price, as leading to an extension of demand which such excellent machines well merited, were met by the assertion that it was *impossible* to reduce the cost without deteriorating their quality. The general progress, however, which has been remarked on already, has worked wonders here as elsewhere. Messrs. Hornsby's great drill, which has long been coveted in vain by farmers of moderate means, with its vulcanized india-rubber tubes, its steerage moving like clockwork with rack and pinion, and its various other improvements, is now reduced in price by the very material amount of 15*l.* 5*s.*, and Messrs. Garrett, nowise behindhand, are earning fresh laurels with their "small occupation" drills. Their cheap corn-drill has been before the public for the last two years, and they have followed it up by the introduction of a cheap turnip-drill, either for ridge or flat work, which, at a trifling additional cost, can be made to act as a horse-hoe. This last addition is an important one; and when next Mr. Garrett wishes to make a "decided hit," he cannot do better than adapt his small corn-drill also for hoeing its own work. The two drills would then form a complete outfit for drill husbandry at such a price as to bring them within the reach of farmers of small capital. This has long been a desideratum; and when a maker like Mr. Garrett, having an

extensive sale for more expensive drills, ventures to disregard any possibility of interfering with such sale by the introduction of a cheaper implement, and boldly to carry out the wishes of the Society, it is right that every publicity should be given to the fact, in the hope that, when the merit of these implements becomes fully known, he may meet with the success which so spirited an attempt well deserves.

Great improvement has been made in the mills for agricultural purposes, the extent of which will be best shown by comparing the performance of the prize mills at Lewes and Exeter. At the Exeter meeting Clayton's mill (price 45*l.*) ground at the rate of about $1\frac{3}{5}$ bushels per horse-power per hour; whereas Hurwood's mill at Lewes (price 20*l.*) ground at the rate of 4 bushels per horse-power per hour, the proportion of work done in the two cases being as 20 to 8. Clayton's mill was doubtless capable of making finer meal, but few farmers require a mill for grinding fine flour; the general demand being for a moderately-priced mill that will reduce barley, beans, &c., to sufficiently fine meal for feeding cattle or pigs, and for this purpose Hurwood's mill seems perfectly well adapted.

Sufficient has now been said to prove that essential improvement has been made in several of the most important implements; the reports of the judges show that similar improvement was observable throughout the greater part of the show. The preamble of this report is therefore proved, and it may be considered an established fact that Progress was a leading feature of the Lewes show. This is very satisfactory, and, to use a phrase in vogue amongst our Gallic neighbours, it is a fact of "immense signification." It is so, because it proves *that equally rapid progress is being made in the adoption of these improved machines by the farming community.* In former reports the important influence exercised by the shows of the Royal Agricultural Society in improving the construction of agricultural implements has been duly pointed out, but no attempt has hitherto been made to furnish any data illustrative of the rapidly extending application of machinery to agriculture: no doubt can, however, be entertained that, notwithstanding all the efforts of agricultural societies, the current of invention and improvement would soon have been checked, and must ultimately have ceased altogether, had it not been closely followed up by a largely increased demand for the machines when improved. It will now be briefly shown from returns furnished by the principal implement makers that the increased demand has fully kept pace with the improvements which have been made. It would be obviously unadvisable to publish the names of those who have been obliging enough to furnish the following information, and it must be understood that the letters A, B, C, &c., are

used solely for the sake of distinction, and have no reference to the initials of the respective makers :—

Steam Engines.

A's "manufacture of steam-engines has within the last three years increased *fourfold.*"

B. "In the last two years has made *five* times as many as he did four or five years ago."

C. "Within three years his manufacture of engines has increased *eightfold,* and still continues to increase."

D. "Made in 1848	. . . . .	15
,, 1851 and nine months of 1852	. .	294."

From his own farming experience the writer feels that a considerable "screwing up of the courage" is required before giving an order for so considerable a purchase as that of a steam-engine, and he confesses, therefore, to no small surprise at the indication afforded by the above returns of the rapidity with which steam is taking the place of any other motive power for driving agricultural machinery.

Thrashing Machines.

E. "Sold in 1849 and 1850	. . . .	56
,, 1851 and nine months of 1852	. .	192"

F. "In 1852 made as many as in the whole of the three preceding years, and could have sold four times that number had it been possible for him to have executed the orders he received."

G. "Turns out at least five per week, and has done this for some years. The demand now is for a more complete machine, which can shake and dress the corn as well as thrash it."

Drills.

H. "Has turned out 30 per cent. more for the last two years than four or five years ago."

I. "Six years ago made seven or eight per week; now makes 25 per cent. more; but, from the introduction of lower-priced drills, does not receive more money than heretofore."

It would be tedious to follow this inquiry through the smaller implements; suffice it to say, that the writer is in possession of numerous interesting letters from the manufacturers, and regrets that want of space compels him to give a very brief selection from the facts they contain. One of the most noted makers of ploughs and harrows dates the introduction of iron into their manufacture from about the year 1840, since which time it has rapidly increased, and at present has almost entirely superseded wood. His own make has increased from 150 ploughs and 120 sets of harrows in 1843, to 1400 ploughs and 520 sets of harrows in 1852. An eminent manufacturer of carts, wheels and axles, &c., states that he sold 727 sets of wheels in the three years 1843-45, and 2334! in 1850-51 and nine months of 1852. A maker of a very popular scarifier in the three years 1846-48 sold 451 of these implements, and in 1850-51 and nine months of

1852 sold 2470! One large firm says that their orders for first-class implements of all kinds have in the last three years increased at least fourfold, and that their foreign orders also have been very considerable since the opening of the Great Exhibition. In short, the nearly unanimous feeling of the writers of the letters in question is, that the demand for improved implements is rapidly increasing, and, as they have the best possible means of ascertaining the fact, their agreement on the point may be considered conclusive. They do not, however, stop here. Some of them directly trace the increase of their sales to their success at the Society's trials of implements—others treat the subject more generally; but all who give an opinion at all agree in attributing the undeniable development that has taken place in the manufacture of agricultural machinery, more or less directly, to the opportunities and encouragement afforded by the Royal Agricultural Society.

In conclusion the writer trusts that he has succeeded in proving that great progress has been made of late both in the *improvement* of agricultural implements and in their *dissemination;* and whilst congratulating the members of the Society on these very satisfactory results, he would also remind them that their importance is much enhanced by their having been realized during a period when the farmer, with truly British pluck, was slowly fighting his way through difficulties of no ordinary kind.

Moat Hall, December, 1852.

JUDGES' REPORT—(FIELD IMPLEMENTS.)

Ploughs for general purposes.—Of this class 16 were selected for trial; and in order to meet the requirements of the kind of land, which was a loam intersected with chalk and flints, they were directed to plough both 5 and 7 inches deep. The ploughs of Messrs. Ransome, Howard, Busby, Ball, and Hensman distinguished themselves by their superior performances; and in order more fully to test their several merits they were conveyed to the "heavy land," and tried at 6 inches deep, making very similar work to that on the previous trial. Ransome was the successful competitor, his plough having turned the furrow-slice with the greatest possible precision. The ploughs of Howard and Busby were in point of accuracy of performance very highly commended. A new feature in the one of Howard's deservedly obtained a medal. The improvement consisted in the application of a box-nave to his wheels, much resembling that of the mail-axle, thereby precluding the possibility of dust, soil, &c., being cast on the spindle. By this means that defect is obviated which is so commonly observed, viz. that the wheels, even if constantly oiled, are ground, as it were, *untrue.*

Heavy Ploughs.—Twelve of this class were selected, and at the trial 9 inches of soil were required to be turned at the best angle, which was left to the discretion of the exhibitors and their ploughmen. In the number were 3 Kentish ploughs, which at even 6 or 7 inches did not cut a uniform furrow-slice, nor was it turned or laid in a good form. Those of Bentall, Ransome, Ball, Williams, Hensman, and Howard were exceedingly good; Busby's was considered to merit the prize.

Turnwrest Ploughs.—Out of the 8 which were tried, those of Howard

and Bentall did the work very efficiently, but, from their unwieldiness and difficulty of alteration, they do not merit a prize in competition with Lowcock's (manufactured and exhibited by Ransome), to which the prize was given. Mr. Pitts, of Kenn, in Devonshire, exhibited one of like character to the one of Lowcock's, but inferior in workmanship.

Paring Ploughs.—Messrs. Glover, Comins, and Ransome were the only exhibitors in this class; the former as usual was decidedly superior for the purpose of paring the sod, &c., at any thickness required, being easy of management, and working level and true.

Sub-Pulverizers.—Nine were brought into the field of trial on the heavy land, varying materially in the formation and arrangement of the tines, as well as in the amount of labour for both man and horse. Read's is the easiest of draught, and scuds away with steadiness and ease, but is found not so effectually to rend and pulverize the substrata as those with tines otherwise arranged. Gray and Co.'s, to which the preference was given by the judges, was not the easiest of draught, but was selected from the very effectual manner in which it broke up the earth through which it passed. The test was severe, the chalk rock being in some places within two inches of the sole of the furrow made previously by the deep ploughs. The leverage attached to this implement was considered a great recommendation from its facilitating the turning at the end of the field.

Heavy Harrows.—Messrs. Coleman, Howard, and Williams competed in this class. Williams's made the best work, and in a masterly style reduced the tenacious clods better than could have been anticipated, considering their hard state. That of Howard was a respectable second. Coleman's power of expansion and contraction might be of service, if capable of being fixed at any angle required, but, as at present constructed, the uneven motion of the horses expands and contracts the harrows when not required to do so.

Light Harrows.—An unusually large number of this class were selected and tested. Howard's accomplished admirably all that could be expected of harrows to perform. This maker has made a further improvement in the joints, and, by the application of a short chain coupling to each, they can at pleasure be made fast, or given what liberty may be deemed requisite to suit any unevenness of surface, furrow sides, &c. &c. Williams's also worked well, as usual. A set exhibited by Allcock, of Ratcliffe-on-Trent, appeared well adapted for separating twitch, &c., on light soils. Woods, of Stowmarket, had a scarifying harrow, which produced a fine tilth for the reception of seeds. Holmes and Son's one-horse harrow was commended as an excellent implement to follow the horse-hoe, &c. Amongst the chain-harrows those of Cottam and Hallen were very effective, but the cost of them was considered extravagant.

Cultivator, Grubber, or Scarifier.—Eleven of these were selected and carried to the light land, most of which were first tested with scarifying shares on a clover ley, the surface of which was of free texture for the season; consequently an imperfectly formed share pared the surface much better than at any previous trial. The shares having been removed and the points substituted for grubbing, the whole were worked across a piece of clover ley, which had been recently ploughed. A good arrangement of the tines was required to enable them to work as grubbers, as the slice lifted in large clods. The superiority appeared to rest between the "Biddell" (exhibited by Ransome and Co.) and the "Uley" (exhibited by Crosskill); but on account of the lever movement in the former for raising or lowering either side of the implement, to it was awarded the prize. Bentall's combined Broadshare and Scarifier worked, as usual, very well as a broadshare, but does not cover the track of two horses abreast, which makes it inefficient as a scarifier.

Pair-horse Scarifiers.—From the freedom of the surface-soil the whole of this class (seven in number) acted efficiently. To the one exhibited by Hart, of

Wantage, Berks, was awarded the prize. It appears an excellent implement for sands or light soils. The leverage and form of the shares are very good.

Hay-making Machines.—Smith's, of Kettering, was again victorious. The simplicity of the contrivance for reversing the motion is very clever.

Ridge-hoes.—Twelve were selected for trial, some of which were not tried, from the absence of the owners. Those of Howard, Busby, Hensman, and Gray were of nearly identical construction, and worked very well. The prize was given to Howard's from its having a long axle in front, which causes the wheels to run in the adjoining intervals to the one which is being hoed; the hoe is consequently more easy to steer as well as to turn at the end of the field.

Horse-hoes on the flat.—Garrett's hoe was again unapproachable. The judges think that any comment upon this sterling and well-known implement would be quite superfluous.

Filling-in Plough.—Mr. Slaney's prize was again withheld: Comins's plough, the only one tried, was decidedly a failure.

Norwegian Harrows.—Of the three tried in this class Kearsley's, of Ripon, was the most efficient. It pulverized the surface for the drill in an admirable manner.

Horse-Rakes.—Nine were tried upon some newly-cut grass where the hay-spreaders had been previously tested. With the exception of Howard's they were all liable to one or other of the following faults, viz. that the grass collected was too much compressed, the delivery unsatisfactory, or the leverage not instantaneous. The judges were divided in opinion as to the superiority of the two first mentioned. They were consequently afterwards tried on clover ley, upon which some straw was scattered, in order to test their merits as stubble-rakes. Howard's was here the most efficient, and consequently received the prize.

Clod-Crushers.—Four were taken to the heavy lands for trial. Owing to the novelty of two of them a close test was entered into by first applying them on the plough seam, afterwards on land which had been some time ploughed and harrowed, imagining Crosskill's would have a near run; but such was not the case; a decided preference was given to the standard implement.

Reapers.—The several exhibitors in this class were Messrs. Thompson, Woods, Holmes, Ransome, Mason, Burgess and Co., Crosskill, Samuelson, Garrett, and Howard—all of which were tried upon a piece of rye nearly ripe and perfectly erect. After a trial of once round the stitch allotted to each, four were selected, one on the "M'Cormick," exhibited by Messrs. Samuelson, and three on the "Hussey" principle, exhibited by Messrs. Thompson, Crosskill, and Garrett. Mr. Ransome would have figured amongst the last-mentioned, but, from some arrangement between him and Mr. Garrett, a second trial was not desired. From a short trial the judges arrived at a conclusion that Garrett's was the best, and Crosskill's the second-best machine; but they are of opinion that these machines must be made much stronger and divested of as much of the complication as practicable, ere they can be generally useful, and further trust that skill and perseverance will be brought to bear on these universally required machines.*

R. Beman.
Thos. Scott.

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* It is my opinion that the reaper will never be an implement upon which a farmer can solely rely for cutting his corn, but may be a useful addition to the scythe. Where the crop stands, and is free from weeds and stones, it works perfectly; but where the crop is laid, and land foul, the stoppages do away with the economical use of the reaper. I came to this conclusion by having tried it on barley where there were seeds.—A. Hamond.

The principle having now been established that corn may be advantageously cut by machinery, there appears to be every reasonable expectation that the machinery itself will, ere long, be so far improved by the perseverance and skill of our manufacturers, and its employment so far adapted to the various conditions of grain crops,

JUDGES' REPORT—(DRILLS, CORN-MILLS, &c.)

In reporting upon the drills this year it appears useless to go minutely through their different items, as they are constructed upon the same general principles as the two previous years, and may fairly be referred to the Exeter Report; though evidently got up with that care and superior style of workmanship which characterized them in the Great Exhibition.

The prize for the best drill for general purposes has this year been awarded to Messrs. Hornsby. This drill at Exeter was considered equal in all respects to any of its class, but the price put it beyond the means of the generality of farmers, so that it did not receive a prize: since then Messrs. Hornsby have reduced it by 15*l.* 5*s.*, and it is now considered fairly entitled to the reward.

The prize for the best steerage corn and turnip drill is also due to Messrs. Hornsby. The drill most perfect of its kind must be the one adapted to every purpose and every emergency, and in which the most material parts are upon the most correct principle. This remark applies generally to Hornsby's prize drills, which have also the advantage of the screw for altering or regulating their motion, which is decidedly preferable to the lever, as causing a less vibrating or jerking motion, and thereby ensuring greater regularity in the distribution of seed or manure. In this respect Messrs. Hornsby excel almost every other maker.

Messrs. Hornsby's turnip-drills, both on the flat and the ridge, were again considered the best. These two drills were very superior, in respect to delivering and covering the manure: the moveable front to the manure-box is at present unequalled by any other appliance for preventing rough or damp manure hanging to the sides; they are also worked with less friction and labour for the horses.

The prize for the best drill for small occupations is again awarded to Messrs. Garrett. This drill is the same as it has been for the last two years, and is becoming a general favourite on light-land farms, on account of its cheapness and easy draught.

The prize for the best seed and manure drill for small occupations is also justly merited by Messrs. Garrett, combining as it does all the essentials of the most expensive manure-drills (with a horse-hoe for a few shillings extra); the whole at a price meeting the wishes of the Society for cheap implements in a most liberal manner, and deserves all the patronage that can be bestowed upon it.

Messrs. Garrett's drop-drill is again the most perfect implement of its kind, suitable either for a drop or stream drill, and to them the prize is awarded. It is but due to the Messrs. Garrett to say that all their drills deserve the highest commendation, and may be said to be the only ones that come into close competition with Messrs. Hornsby.

The manure-distributor of Messrs. Garrett richly deserves the Society's prize this year, approaching a greater degree of perfection than any hitherto brought before the public. The self-acting levers, to rid the prongs of the revolving barrel of all adhering particles of damp manure, is a desideratum long required, and now accomplished in a most simple and effectual manner. This machine will cause a great saving of labour in broadcasting artificial manure; but it ought to be mentioned that the receiving-trough of the one exhibited by Messrs. Smyth, of Peasenhall, appears to be upon a better construction.

Regret may justly be expressed that many of our oldest drill-manufacturers stick to what they call their original ideas; and, as an intelligent mechanic remarked, when charged with pirating a notion, if we all stick to original ideas, I wonder what will become of the Royal Agricultural Society.

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as to bring it into general use—a result which must tend to greater attention being directed to the preparation of the land, and to the adoption of the most improved systems of cultivation.—WM. FISHER HOBBS.

The best mill for breaking agricultural produce into fine meal is unquestionably Hurwood's, of Ipswich. This mill ground at the rate of above six bushels per hour, with the application of only 1-horse power, making excellent work. It approaches nearer to the requirements of a farm than any hitherto exhibited; is easily managed by any intelligent labourer, and not liable to get out of repair. The grinding surfaces of this mill are fitted with a series of cutting rings, easily replaced by new ones, in case of accident, or when worn out. It will grind linseed, barley, oats, beans, and maize, for feeding cattle and pigs, as well as French stones would do; and is superior to that kind of stones for splitting beans or oats for horses, or grinding malt. We accordingly awarded it the prize.

All the mills were allowed to grind till they had settled fairly to their work, when the result of five minutes' work was correctly ascertained, and was as follows:—

Names of Exhibitors.	Kind of Mill.	Horse-power required.	Fine Meal ground in 5 Minutes.	Remarks.
			lbs.	
Hurwood. .	Metal	$1\frac{1}{2}$	31	Well adapted for farm produce.
Crosskill . .	Metal	4	15	Would grind very hard substances.
Ransome . .	French Burr stones	4	43	Adapted for fine flour.
Whitmee .	French Burr do. .	1	16	Made rough work.
Hayes . . .	Derbyshire Peak do.	3	30	Did its work well.

The metal mill of Messrs. Crosskill deserves attention for grinding bones and coprolites, which it does exceeding well. Messrs. Ransome's is more adapted for fine flour: the expense and superiority of workmanship place it beyond the means of a farm. Mr. Hayes's Derbyshire Peak stones ground well and economically, and the meal was well suited for cattle or pigs. Mr. Whitmee's ground fast, but made bad work, which accounts for the small amount of power consumed.

T. Hawkins.

Judges' Report—(Steam Engines.)

In making our report we would notice the introduction, for the first time, of prizes for stationary engines, which the Society has added, with the view to encourage improvement in this class of engines, which, in its effects, we think, will be highly useful to the agricultural interest, as, although the moveable engine has attained to great perfection, we consider there are many instances in which the stationary engine will be found preferable. Those exhibited at Lewes were of good manufacture, yet we would suggest that the designs might be modified so as to embrace greater simplicity.

With reference to the performance of the stationary engines, we think it would not be advisable to publish any tabular statement of results, inasmuch as, by the mode of trial adopted, viz. with two portable boilers coupled, to be worked by two fires, no result to be relied on as showing the capabilities of the engines could be attained: we therefore would simply state that we considered Messrs. Barrett, Exall, and Co. to have merited the first, and Messrs. Ransomes and Sims the second prize; and we would suggest that, at the next meeting, each party bring a boiler to attach to their fixed engine, or that a boiler upon wheels, of sufficient heating surface to supply the fixed engine of the highest power exhibited, be furnished by the Society, for the purpose of enabling the judges employed to test this class of engines, so as to arrive at results sufficiently definite to justify them in publishing their report in detail.

With reference to the moveable engines, the most favourable results as

regards economy of fuel have been obtained, which must be viewed with peculiar satisfaction by the Royal Agricultural Society, from their having been the means of calling forth that talent which has given to the British farmer the moveable steam-engine, and other machinery, in so great a state of perfection.

The number of these engines exhibited at Lewes was much greater than at any previous meeting, and the improvement in them very evident; we would, however, suggest that, in lieu of expending money on ornamenting or beautifying the engine and boiler by unnecessary labour, it be spent on the essential parts, by using the best material that it is possible to procure, and by perfecting the workmanship.

A moveable steam-engine, having to be exposed to the weather, is the better for the absence of bright work where not really required, as it is rarely kept clean, and the material that has to be employed in getting off the rust frequently finds its way into the bearings, and produces great injury.

We now proceed to notice the engines.

Messrs. Clayton, Shuttleworth, and Co.'s 6-horse moveable engine was, in construction, similar to that exhibited at Exeter, of very good workmanship, and fire-box furnished with copper tube plate and copper bridge, with a view to economise fuel—a result, in this respect, exceeded by two other competitors; but still we consider this engine in every way creditable to the makers, and worthy to be "*highly commended*." The 4-horse engine, by the same makers, resembled the above for the most part; but some of the appliances for saving fuel being omitted in this case, and the engine being also of smaller power, the result worked out was inferior to the 6-horse.

Mr. Freeman Roe, Strand, London: 4-horse moveable engine: workmanship very inferior: general arrangement ill-designed and clumsy, with cast-iron freely used in the place of wrought. The duty done will be seen, on reference to the tabular statement, to have been 93·9 lbs. of coal per horse-power per hour.*

Messrs. Hornsby and Son: 6-horse moveable. This engine standing first in its class with respect to economy of fuel, and being very good both in construction and workmanship, we considered it to be deserving of the first prize. The cylinder of this engine being within the steam-chest of the boiler prevents condensation, and retains the pressure throughout the stroke of the piston; to this arrangement we attribute the high duty of the engine and its economy in fuel; the arrangement of the cylinder and force-pump also rendering it impossible that any accident can occur on first putting the engine to work in frosty weather, by preventing ice from being formed in them. Several of the details are very good and deserving of attention, viz. the mode of compensation for the wear of the guide-brasses of the piston, and the method of lubricating the same, being, in our opinion, very effective.

The hinder axle being cranked, and embracing the fire-box at the back, obviates the necessity of removing the axle when any repairs are needed to the fire-box.

The ash-pan is well placed, completely enclosing the furnace, and rendering the whole more safe from accident by fire; the governors are very good and sensitive; hence the admirable steadiness with which the engine worked.

No. 2: a 4-horse portable, by the same makers: similarly constructed to the above, but of smaller power, and without the water-heating apparatus, which will account for the duty being less than that of the prize engine; but still the result in this instance also was very satisfactory.

* Mr. Freeman Roe has written to request that the result of the trial of his engine might not be published, as in taking it to pieces he discovered that it had been wrongly put together. This may be quite true; but an exhibitor who does not ascertain that his engine is in working order before it goes to trial has only himself to blame should the result be unsatisfactory; and to allow of the withdrawal of the recorded performance of an implement which has worked badly would be to establish a most inconvenient precedent. The application was consequently refused.—H. Thompson.

Mr. W. C. Cambridge: 5-horse moveable. The workmanship of this engine was inferior, and duty below the average.

Mr. Alfred Sparke: 5-horse moveable. This engine, in its construction, was simple; parts well arranged; workmanship fair; and duty quite up to the average.

Messrs. Garrett and Son: 6-horse moveable. One of the peculiar features in this engine is the substitution of wrought iron for cast, wherever practicable; the bearing of crank-shaft is wrought iron, very firmly seated on the end of the boiler, the same plate being beaten out to form the end of the smoke-box; the water-heating tank, also, is well arranged, being composed of an external and internal case, and the water between the two, with the exhaust-steam from cylinder, passing through the inner case, where a certain amount of condensation takes place, and the product in pure water, to the amount of about 25 per cent., returned through the force-pump to the boiler, which is of some considerable moment where the water used is subject to produce incrustation; the foot valve force-pump was on a level with the supply-tank, which is practically of great advantage. We would also notice a clever application of a spring sunk within a groove in the axle of the carriage of this engine, which effectually prevents concussion when passing along a rough road. The duty done, in this case, was very creditable; the quantity of coal used and time occupied in getting up steam very little; and, although the consumption of fuel by this engine was a little more than some of its competitors, we would account for this, in a measure, by the shape and smallness of the fire-box, which these manufacturers have adopted for the purpose of obtaining increased strength, combined with less weight. The workmanship of this engine was very good, and we deemed it, as a whole, quite worthy to be "*highly commended*."

The 5-horse engine, by the same makers, was not fitted to work so economically as regards fuel, but was, nevertheless, a plain, strong engine.

Messrs. Tuxford and Sons: 4-horse moveable. The boiler of this engine is composed of 2 flues opening into the fire-box, having return tubes into the smoke-box at the fire end; the cylinder works vertically, and is placed in a wrought-iron box at the end of the boiler; a very neat arrangement, and useful as keeping dust from the working parts. This engine was creditably turned out as regards workmanship; did fair duty: we felt pleasure in commending the same.

No. 2, by the same maker, also 4-horse; differing from the above in the cylinder being on the oscillating principle, and the boiler a tubular one. This engine was very compact, light, and portable, but consumption of fuel above the average.

Messrs. Hensman and Son: 5-horse moveable. A plain engine, of moderate workmanship; small heating surface in boiler, and consumption of fuel more than any of its competitors, with one exception.

Messrs. Holmes and Son: 6-horse moveable. An engine of good design and fair workmanship; commenced working satisfactorily; but, in consequence of the force-pump failing, the trial was stopped, and credit given for the coal remaining unconsumed; but for this accident the duty done would doubtless have been more satisfactory.

Mr. Eaton: 6-horse moveable. This engine had the cylinder placed in the smoke-box, and the boiler containing a fair amount of heating surface, with a workmanship creditable; the result was so far satisfactory that we thought it worthy, "considering also the lowness of price," of a commendation.

Messrs. Barrett, Exall, and Andrews: 6-horse moveable. To this engine was awarded the second prize; and we were very glad to observe that the firm had made considerable improvement in the arrangement and principle of their engine, in consequence of which the economy in the consumption of fuel was apparent, as will be observed on reference to the tabular statement.

These makers have adopted a novelty in the construction of their engine, which consists of a casing encircling the lower portion of their boiler, for the purpose of conveying the heated gases from the ends of the small tubes to the smoke-box of the chimney, which is placed at the fire end of the boiler; the products of combustion are passed by this means through nearly twice the length of the boiler instead of once, according to the practice of most of the other makers; and as the cylinder is placed in the smoke-box, condensation of steam is prevented thereby: the boiler is supported on improved trusses, inside and outside. The slide of this engine is economically worked by expansion gear, 9 inches out of 12 inches, and further economy is also obtained by an excellent arrangement for heating the water previous to its being forced into the boiler.

No. 2, by the same makers: 4-horse moveable; with plain tubular boiler without water-heating apparatus; of moderate workmanship, and comparatively small heating surface exposed in boiler, which resulted in a small amount of duty done for coal consumed, as shown by reference to the tabular statement.

Messrs. Ransomes and Sims: 6-horse moveable. This engine was well made, and the arrangement of its working parts good; the boiler presented a fair amount of surface; the carriage was well constructed; and we would notice particularly the turn-plate composed of a spherical and concave surface, brought together so as to maintain the perpendicular of the engine when passing over uneven ground. We consider this an important improvement, in a practical point of view, as preventing any cross strain that might otherwise occur from the irregularities of the road affecting each pair of wheels transversely. In this engine steam was taken from the boiler by a slit-pipe passing nearly the whole length inside, within a short space of the top, and opening into a stop-box, of good construction. This arrangement we considered beneficial, as tending to prevent priming: the duty done was creditable, and we felt pleasure in commending the engine. The 4-horse moveable, by the same parties, is similar to the above, and worked out a corresponding result.

Name of Manufacturer.	Nominal Horse-power.	Time getting up Steam.	Coal used in getting up Steam.	Coal burnt per Horse-power per Hour.
		Minutes.	lbs.	lbs.
Clayton, Shuttleworth and Co., No. 1	6	32½	22·75	6·00
,, ,, No. 2	4	41	29·50	8·40
Freeman Roe	4	75	63.00	93·90
Hornsby and Son, No. 1	6	50	30·20	4·66
,, ,, No. 2	4	47	24·90	6·05
Cambridge	5	36	19·40	14·30
Sparke	5	44	32·16	9·26
Garrett and Sons, No. 1	6	32	19·09	7·10
,, ,, No. 2	5	69	34·10	9· 9
Tuxford and Sons, No. 1	4	52	22·1	8·48
,, ,, No. 2	4	35½	21·4	11·90
Hensman and Son	5	52	19·7	17·90
Holmes and Son	6	41	17·5	16·60
Eaton	6	47½	61·5	8·83
Barrett, Exall, and Andrews, No. 1	6	49	23·5	5·45
,, ,, No. 2	4	36½	20·70	11·45
Ransomes and Sims, No. 1	6	56	33·16	8·03
,, ,, No. 2	4	50	24·25	9·50

CHARLES JOHN CARR, Belper.
WILLIAM OWEN, Rotherham.

JUDGES' REPORT—(THRASHING MACHINES, CHAFF-CUTTERS, &c.)

TWO-HORSE POWER MOVEABLE THRASHING MACHINES for Small Occupations.

Perfect Work is represented by					20	12	8	40	
Stand.	Article.	Name.	Number on Counter.	Time Thrashing 60 Sheaves.	Clean Thrashed.	State of Corn.	State of Straw.	Comparative Excellence.	Price. £. s. d.
52	10	Hensman. . . .	819	7,1	18	11	6	35	36 10 0
54	15	Garrett and Son . .	823	7,1	19	11	7	37	36 0 0
73	50	Ransome and Co. .	739	6,4	10	11	8	29	36 0 0
72	11	Barrett and Co. . .	888	7,7	10	11	8	29	37 0 0
19	4	Cambridge . . .	1566	13,5	19	10	6	35	33 0 0

The prize for this machine was awarded to Messrs. Garrett and Son. From the above table it will be seen that their machine obtained the greatest number of good marks, and that it was only beaten in point of time by one other; which, from the hasty manner in which it was fed, thrashed very badly. There is nothing particular to remark respecting these machines, excepting the great difference in the time taken to do the same amount of work.

MOVEABLE THRASHING MACHINES, not exceeding Six-horse Power, for Large Occupations.

Perfect Work is represented by						20	12	8	40	
Stand.	Article.	Name.	Horse-power.	Number on Counter.	Time Thrashing 100 Sheaves.	Clean Thrashed.	State of Corn.	State of Straw.	Comparative Excellence.	Price. £. s. d.
73	52	Ransome and Co. .	4	741	6,4	18	10	7	35	59 17 0
1	26	Crosskill	4	790	6,8	19	8	7	34	52 10 0
72	8	Barrett and Co. . .	4	839	7,3	15	10	7	32	59 0 0
79	1	Woods	4	988	8,8	18	9	7	34	55 0 0
57	2	Smith, Uxbridge .	3	844	7,3	10	11	7	28	40 0 0
17	1	Tasker	4	1,074	9,3	17	11	7	35	54 10 0
70	1	Carpenter . . .	4	1,234	10,7	17	11	7	35	69 0 0
60	4	Holmes	5	722	6,2	18	10	7	34	60 0 0
54	16	Garrett and Son . .	4	681	5,9	20	9	7	36	56 0 0
19	2	Cambridge . . .	4	584	4,7	8	10	8	26	45 0 0
58	11	Hensman. . . .	5	690	6,0	20	9	7	36	78 10 0
		Ditto, reduced to .	4	862	7,5	..	..	..	..	..

This prize also was awarded to Messrs. Garrett and Son. On reference to the above table, it will be seen that Messrs. Hensman's machine was equal to the prize one in the goodness of its performance; but though it had 5-horse power, it was rather longer in doing the same quantity of work; and when reduced to equal power, the difference in time is considerably in favour of Messrs. Garrett's. There is also a considerable difference in the price. With three or four exceptions, the work done by the above machines was very satisfactory.

Moveable Thrashing Machines, not exceeding Six-horse Power, with Shaker and Riddle, to be driven by Steam Power.

Perfect Work is represented by						20	15	15	12	8	70	
Stand.	Article.	Name.	Horse-power.	Number on Counter.	Time Thrashing 100 Sheaves.	Clean Thrashed.	Clean Shaken.	Clean Riddled.	State of Corn.	State of Straw.	Comparative Excellence.	Price.
												£. s. d.
58	12	Hensman . . .	5	919	8,0	20	..	10	10	8	48	65 0 0
54	19	Garrett and Son .	6	859	7,4	20	13	10	11	8	62	60 0 0
57	1	Smith	5	1,348	11,6	10	..	10	12	8	40	52 10 0
52	2	Sparke . . .	5	893	7,7	17	13	8	11	5	54	50 0 0
56	9	Tuxford . . .	6	723	6,3	..	8	5	11	8	32	65 0 0
11	4	Hornsby . . .	6	1,093	9,5	16	15	14	10	8	63	67 0 0
6	9	Clayton and Co. .	6	943	8,2	18	15	14	11	7	65	75 0 0
60	3	Holmes and Son .	6	666	5,8	18	15	..	11	6	50	80 0 0
73	53	Ransome and Co..	6	701	6,1	16	12	10	11	8	57	85 0 0

This prize was awarded to Messrs. Clayton and Shuttleworth. It will be seen above that they had several very formidable competitors, and the above list includes three or four other very excellent machines. Though not required by the conditions of the prize-sheet, the last five in the above table had blowers attached to them, and dressed the corn in a most satisfactory manner, so that most of it would only require to be once dressed with a finishing machine. The chief fault of these machines is their great height from the ground to the feeding-stage. In this respect Messrs. Hornsby's is much less objectionable than any other. In some of them, also, the dressed corn falls into confined spaces under the machines, and they would require great attention when at work to prevent their being blocked up with corn. From this defect those of Messrs. Clayton and Co., Hornsby and Son, and Ransome and Co. are exempt; the two last delivering the corn into sacks if required.

Fixed Thrashing Machines, not exceeding Six-horse Power, with Straw-shaker, Riddle, and Winnower, that will best prepare the Corn for the finishing Dressing-Machine: to be driven by Steam Power.

Perfect Work is represented by					20	15	10	15	12	8	80	
Stand.	Article.	Name.	Number on Counter.	Time Thrashing 100 Sheaves.	Clean Thrashed.	Clean Shaken.	Clean Riddled.	Clean Chaffed.	State of Corn.	State of Straw.	Comparative Excellence.	Price.
												£. s. d.
60	3	Holmes . . .	666	5,8	18	15	..	..	11	6	50	80 0 0
73	53	Ransome . . .	701	6,1	16	12	7	5	11	8	59	75 0 0
54	18	Garrett . . .	674	5,8	18	13	10	14	11	7	73	65 0 0
6	10	Clayton and Co. .	1,168	10,1	19	14	10	15	11	8	77	180 0 0

This prize was awarded to Messrs. Garrett and Son. It will be seen, however, by reference to the above table, that Messrs. Clayton and Shuttleworth exhibited a machine that obtained higher marks of approbation, though it took much more time in doing the same work. But, it not only prepared the corn for the finishing dressing machine, but by means of elevators passed it through two other dressing machines, and finished it in the most perfect manner, and weighed it into sacks ready for market. Indeed, it performed every operation of thrashing, shaking the straw, separating the chavings from the chaff, and the light corn from the best; and again dividing the tail corn into best tail, light tail, and whites, to the entire satisfaction of the judges. But as Messrs. Garrett's machine did all that was required of it by the *conditions specified in the Prize Sheet*, in a very satisfactory manner, and in a very short time, the judges did not feel justified in giving the prize to Messrs. Clayton and Co., but recommended their machine to the Council for the Society's Gold Medal.

The judges regret that the Society was unable to provide them with barley for the trials this year. They are of opinion that it is by far the best test of the merits of a thrashing machine; for if it will perfectly thrash, shake, and dress barley, without injuring it for malting purposes, it will be certain to perform the same operations on wheat and other corn in a satisfactory manner. They therefore recommend that, if the machines cannot be tried with both kinds of grain, barley instead of wheat should be provided for future trials.*

The judges cannot conclude their remarks on the thrashing machines without congratulating the Society and the public on the great improvement that has taken place in them during the last two years. Those exhibited this year show that portable ones, capable of doing an immense amount of work with the assistance of very little manual labour, are now within the reach of farmers of even moderate means; and that fixed machines, economizing labour to a still greater extent, and doing perfectly, at one operation, that which has hitherto, in a general way, been very imperfectly done at several, are now obtainable by occupiers of more ample means. The want of such machines has long been, and is every day more urgently felt, and the judges have great pleasure in recommending any of those well spoken of to the notice of their brother farmers.

Corn-dressing Machines.

Stand.	Article.	Name.	Weight on Lever.	Tail Corn, first Dressing.	Time of Second Dressing.	Best Corn finished.	Tail Corn, second Dressing.	Height of Feeding-box.	Price.
					m. s.	lbs.	lbs.	ft. in.	£. s. d.
23	2	Cooch	12	9 galls.	1 27	$275\frac{1}{2}$	51	4 9	15 0 0
35	61	Cottam and Co. .	12	$8\frac{1}{2}$ lbs.	1 40	169	$2\frac{1}{2}$	4 11	14 0 0
44	29	Wm. Dray . .	10	11 lbs.	1 31	125	$6\frac{1}{2}$	4 8	10 10 0
15	2	Mason	8	$13\frac{1}{2}$ lbs.	1 25	$77\frac{1}{2}$	$6\frac{1}{2}$	4 5	10 10 0
11	5	Hornsby . . .	12	$21\frac{1}{2}$ lbs.	2 14	444	$31\frac{1}{2}$	4 7	13 10 0

At this trial each machine chaffed as much corn, rough from the thrashing machines, as their exhibitors were able to get through them; each being allowed sixty-two turns of the testing machine, which is equal to two minutes of time. They then finished what they had chaffed, and the results are given in the above table. It is hardly necessary to say that the prize was awarded to Messrs. Hornsby. The capabilities of their machine in chaffing corn

* As one of the stewards I perfectly concur with the judges in this remark.—W. F. Hobbs.

direct from the thrashing machines, with a large admixture of long straws and all the chavings, are still unrivalled, and it is scarcely excelled as a finishing machine.

LINSEED AND CORN CRUSHERS.

Stand.	Article.	Name.	Time in Crushing 7 lbs. of Linseed.		Comparative Power required.	Time in Crushing 4 lbs. of Oats.		Comparative Power required.	Quality of Work, 20 representing Good Work.	Price.		
			m.	s.		m.	s.			£.	s.	d.
9	1	Stanley	3	25	2438	3	10	2744	18	12	0	0
22	11	Richmond . . .	4	27	5382	4	41	3625	16	6	10	0
79	11	Woods	4	4	4662	2	9	2622	19	12	0	0
72	19	Barrett and Co. . .	3	18	4182	2	42	2856	16	8	2	0
54	26	Garrett	4	30	4031	1	24	1656	18	11	0	0
65	14	Carson	4	30	3197	1	48	1705	13	6	0	0
62	4	Turner	6	0	4255	1	55	1770	14	9	9	0
21	16	White	3	50	3332	1	37	1400	13	7	7	0

This prize was awarded to Messrs. Stanley. Their nearest competitors had machines on their principle. For linseed, for which they are best adapted, it was superior to all in regularity of feed and lightness of draught, and to most of them in quality of work. It has a new and clever arrangement for regulating and adjusting the feed.

HAND CHAFF-MACHINES.

124 turns of Testing Machine were allowed to each Chaff-Machine—equal to 4 m. of Time.

Stand.	Article.	Name.	Weight of Chaff Cut.	Weight Cut per Hour.	Weight on Lever.	Power required to Cut 1 lb. of Chaff.	Price.		
			lbs.	lbs.	lbs.		£.	s.	d.
16	2	Allcock	7	105	15	2,14	7	0	0
54	29	Garrett	$5\frac{3}{4}$	$86\frac{3}{4}$	12	2,08	6	6	0
41	1	Bennett	9	135	14	1,55	5	0	0
73	60	Ransome	15	225	25	1,66	6	0	0
22	5	Richmond . . .	12	180	14	1,16	9	0	0
48	6	James Cornes . .	13	195	17	1,30	4	15	0
44	33	William Dray . .	$14\frac{1}{2}$	$217\frac{1}{2}$	17	1,17	12	0	0
55	9	Smith, Stamford. .	16	240	24	1,50	9	0	0
57	12	Smith, Uxbridge .	$8\frac{1}{2}$	$127\frac{1}{2}$	15	1,76	4	10	0
65	8	Carson	$4\frac{3}{4}$	$71\frac{1}{4}$	11	2,31	4	0	0

This prize was awarded to Mr. James Cornes. It will be seen above that he was in several cases exceeded in quantity, but it was generally at the expense of quality. That, taken into account with the easy draught and low price of his machine, entitled it, in the opinion of the judges, to the prize.

CHAFF-CUTTERS FOR HORSE OR STEAM POWER.

360 revolutions on Engine, equal to 3 m. of Time, allowed to each Machine.

Stand.	Article.	Name.	Weight of Chaff Cut.	Chaff Cut per Hour.	Horse-power used.	Chaff Cut per Horse per Hour.	Price.
			lbs.				£. s. d.
48	1	James Cornes . .	68	1360	2	680	14 0 0
63	10	Williams. . . .	55½	1110	2	550	14 14 0
73	61	Ransome	39½	790	1	790	14 0 0
55	6	Smith, Stamford. .	56½	1130	2	565	16 0 0
72	22	Barrett and Co. . .	43	860	2	430	14 5 0
16	1	Allcock	36½	730	2	365	10 10 0
22	7	Richmond . . .	55½	1110	1	1110	9 0 0
55	27	Garrett and Son. .	107	2140	2	1070	14 14 0

This prize was awarded to Messrs. Richmond and Chandler. It will be seen above that their machine produced the greatest amount of chaff per horse-power, and the quality of it was very superior. The knives are in quite a new form, and promise to be very effective. Its price also is very moderate. The judges beg to commend the machine of Messrs. Smith, of Stamford, for a side lever, by which the feeder can reverse the action of the machine (even if both hands should be caught in the rollers), by pressing his body against the lever. They are of opinion, from the number of accidents that have occurred, that all chaff-machines driven by horse or steam power should be perfectly under the control of the feeder under *all* circumstances, and suggest that in future none be eligible for prizes that are not so arranged.

J. P. OUTHWAITE.
OWEN WALLIS.

JUDGES' REPORT—(MISCELLANEOUS CLASS.)

Waggons.—There were only two persons who exhibited for this prize, Crosskill and Ball; and although neither of the waggons was faultless, they were both thought to possess sufficient merit to deserve the prize, which was divided between them. The judges recommend in future that both the hind and fore wheels should be put further forward on the body, particularly when the fore wheels are kept low for the purpose of turning; they also think the fore wheels need not be made so strong as the hind ones.

Turnip Cutters.—The three following were tried, and the result appears below: but from the defective construction of Burgess and Key's, the prize was awarded to Samuelson's. The sample when cut for sheep by the two machines above named was equal, but for cattle Burgess and Key's had the advantage.

Name.	Stand.	Article.	Revolutions on Break.	Weight on Break.	Quantity of Roots Cut.	Comparative Power to do the Work.	
				lbs.	lbs.		
Samuelson . .	5	2	23	12	28	276	For Sheep.
			33	12	28	396	,, Cattle.
Burgess and Key	64	4	36	9	28	324	,, Sheep.
			18	8	28	144	,, Cattle.
Bennett . . .	21	15	21	17	28	557	,, Sheep } Bad work.
			15	11	28	165	,, Cattle } Bad work.

Gorse-Crushers.—Two of these machines were tested, but the gorse was too rough and dry for the experiment. The prize was awarded to Barrett, Exall, and Andrews', which did its work well.

Name.	Stand.	Article.	Time in Minutes.	Horse-power.	Quantity Crushed.	
					lbs.	
White	21	1	2	3	$6\frac{1}{2}$	
Barrett and Co. .	72	29	2	3	11	Made the best sample.

Weighing Machines.—After a close inspection of these useful articles, it was decided that Hill and Co.'s was, from its simplicity, slightly the best. Several other makers possess good machines either for light or heavy weights, but particularly the latter. We wish to notice favourably those of James and Co., H. A. Tompson, and Mapplebeck and Lowe.

Tile Machines.—Four machines were started for this prize, each of which possesses considerable merit. They began by screening the clay which they were to use, and then made pipes as near two inches in diameter of bore as they could; but as the makers did not possess dies of the same size, the judges recommend that in future the required diameter of pipe and width of bore should be stated in the prize list, which would allow a much more accurate comparison to be made. Mr. Scraggs exhibited a novel plan of superseding a collar in many instances, at the small extra expense of 2*s.* per 1000. The prongs of the horse have a conical collar, which is forced into the tiles when they are taken from the machine; one end of the pipes is thus funnel-shaped:

the pipe is then removed and stands a few hours, when it has the other end cut round on the outer side to enable it to fit the wide end of another tile. This idea seemed to the judges to deserve a medal; but experience must decide whether the plan can be advantageously adopted in practice. The diagram below will show the data from which the judges decided that Mr. Scraggs' machine was the best:—

Name.	Stand.	Article.	Width of Bore.	Number of Pipes and their Lengths.		Revolutions of Testing Machine while driving Piston forward.	Total Revolutions during which the Men were employed.	Weight on Break.	Number of Men employed.	Price.		
			In.	Pipes.	In.			lbs.		£.	*s.*	*d.*
Scraggs . .	46	1	2	102 6	$13\frac{1}{2}$ 10†	108	155	14	2	16	0	0
Williams. .	63	18	$2\frac{1}{4}$	56 4	$13\frac{1}{2}$ 29†	133	155	8	2	16	16	0
Armitage. .	27	1	2	45 5	13 24†	107	155	8	2	14	0	0*
Kearsley . .	45	1	$2\frac{1}{16}$	56 8	$14\frac{3}{8}$ 59†	111	155	13	2	29	0	0

* The top tier of tiles crushed the bottom.

† These figures show the number and length of the streams of clay which had passed through the machine, but had not been cut into lengths when the given number of revolutions was completed.

Draining Tools.—Mapplebeck and Lowe received the prize.

Steaming Apparatus.—Stanley received this prize; it was tried in competition with Thompson's, and the result of the trial was decidedly in favour of the former.

Oil-Cake Crushers.—Hornsby's was the best; the teeth on the rollers were the best calculated to keep clean. Below are the performances of the three tried—each being allowed to crush ten pounds of cake, both as food for cattle and as manure.

Name.	Stand.	Article.	Price.	Quantity Crushed.	Revolutions.	Weight on Break.	Comparative Power.	
			£.	lbs.				
Hornsby . . .	11	16	7	10	37	7	259	For Manure.
				10	$33\frac{1}{2}$	6	201	,, Cattle.
Nicholson . .	33	4	5	10	60	7	420	,, Manure.
				10	37	$2\frac{1}{2}$	97	,, Cattle.
Garrett . . .	54	30	9	10	51	7	357	,, Manure.
				10	32	$3\frac{3}{4}$	120	,, Cattle.

Churns.—We commended Burgess and Key's American Churn.

Steel Digging Forks.—The perfection to which the manufacturers of these articles have attained deserves to be more generally known. With the consent of the exhibitors of these forks we made experiments on the strength of the prongs. We commenced by locking two five-tined forks into each other and placing their backs downwards over a round piece of hard wood. We then weighted the handles, so that the strain upon the five tines would be equal to half a ton, but without breaking or permanently bending any of the tines. We afterwards put 21 stone upon the end of one prong of each fork, in this case also without injuring them. We awarded a medal to Burgess and Key for their five-tined fork: weight 4 lb. 15 oz., length of prong $13\frac{1}{2}$ inches, manufactured by Winton and Sons.

Highly commended—Thompson's five-tined digging fork, and Mapplebeck and Lowe's four-tined fork: weight 4 lb. 12 oz., length of prong $12\frac{7}{8}$ inches, manufactured by Lyndon.

Trussed Whippletrees.—The judges think it necessary to comment upon the serious defect which they observed in the main or (what ought to be) the equalizing whippletree—for this trussed main bar, instead of equalizing the draught, will in all cases increase the weight upon the horse that goes in advance, and proportionally take it off the other, so that this description of bar might seriously injure a spirited quick-stepping horse without any danger being suspected by the driver. Mr. Ransome exhibited the only set in the yard which had not the defect alluded to above; but we hope he will improve his main bar so that a farmer may proportion the load between a strong and a weak horse, or between two horses on one side and one on the other.

Gates.—Hill and Co. exhibited a gate, scientifically made, which we highly commend; price 1*l.* Also a trussed gate, which we should have highly commended, but the truss was too long, which made it liable for horses or cattle to get their legs between the diagonal bars and the gate. Thompson's hinge for a heavy park-gate, Art. 243, deserves notice; also his iron stile, Art. 255.

Dynamometer for taking draught of Ploughs.—Bentall exhibited one of these instruments, to which we awarded the prize; although we did so, we cannot recommend it to the public as perfect. It at present has the defect of registering the weight of its own carriage along with that of the plough. We

also think it desirable that it should register the inequalities of the draught of ploughs as well as the average draught.

The judges noticed the following useful articles :—St. 29, Art. 3 : Brown's four-bushel sacks, price 2*s.* each, an excellent article.—St. 1, Art. 33 : Crosskill's root-washer; also Art. 21 : farm railway.—St. 4, Art. 2 : M. Neill and Co.'s stone-ware pillars for rickstands ; it would be advisable to make these pillars thicker at the bottom and top.—St. 32 : Read's collection of watering-machines ; also we wish to call especial attention to his injecting instrument, Art. 5.—St. 23, Art. 5 : Cooch's sack-holder.—St. 33, Art. 18 : Nicholson's cottage stove.—St. 35, Art. 38 : Cottam and Hallen's odometer. — St. 44, Art. 43 : Deane and Dray's mangle. —Art. 73 : Deane and Dray's flax-seeding machine. — St. 57, Art. 15 : Smith's gravel-screening machine. — St. 77, Art. 162 : Thompson's hames, price 4*s.*—St. 20, Art. 65 : Barnard's iron window-frames, 3 feet by 2 feet 6 inches, price 12*s.*, glazed 17*s.*, cheap and good.—St. 74, Art. 7 : Harwood's specimens of ventilating windows.—St. 91, Art. 4 : Young and Co.'s iron hurdles, cheap, but the end standards are too weak where the foot-plates are welded to them.—Hill and Co., St. 59, Art. 64 : a good moveable hurdle for sheep.

William Lister.
James Hall Nalder.

N.B.—Mr. Hawkins was substituted for Mr. Lister as a judge of carts ; the latter gentleman having given his friendly and valuable assistance to Mr. Busby in constructing his carts on correct mechanical principles.—(Ed. Implement Report.)

Carts.—The cart exhibited by Busby received the prize. It is unnecessary to comment on this implement, the maker having previously received a prize from this Society for one of a similar construction, and no other having been brought out which we consider its equal. Messrs. Crosskill exhibited a cart, which we cannot omit to mention, which was very similar in construction to Mr. Busby's.

James Hall Nalder.
Thomas Hawkins.

Consulting Engineer's Report.

Although the Lewes Show may not have been so numerously attended by visitors as on some former occasions, it was not because the implement-makers did not do their best to render it as useful and attractive as any of its predecessors. The productions of most of the exhibitors being truly specimens of their skill, divested the show-yard of that bazaar-like appearance it has assumed at some of the Meetings.

The public had some new implements of an important character introduced to their notice, and from the particulars given in the following statement it will be seen that this Meeting deserved to be ranked higher than that at Exeter in 1850 :—

	Lewes.	Exeter.
Implements entered	1722	1197
Value of ditto (exclusive of Roots, Seeds, &c.), as near as can be ascertained, amounted to . . .	£19,121 5 8	£12,182 10 7
Exhibitors entered	103	118

For although the exhibitors were rather less in number, the implements were more in number, of a higher class, and of greater value.

The Reports of the Judges in the several departments, being so well particularized, leave but little to be described, and that very generally.

Referring to the Awards of Prizes, it will be seen that Messrs. Hornsby and Son took the first, for their portable steam-engine, and some improvements in the details of their engine placed Messrs. Barrett, Exall, and Andrews for the second prize. The table in the Report of the Judges will show that the engines of Messrs. Clayton and Shuttleworth, Garrett, Ransome and Co., Tuxford, and Eaton, will not be extravagant in their consumption of fuel; for, taking the average price of coal at 18*s.* per ton, the prize engine of Hornsby and Co. will cost 2*s.* 6*d.*, and that of Eaton 4*s.* 9*d.*, for the fuel required for 10 hours' working and getting up the steam in the morning; the engines of the other makers just mentioned will range between the two sums of 2*s.* 6*d.* and 4*s.* 9*d.* for working the same time.

Some of the engines of other makers were much behind in point of economy, and one exhibitor was much disappointed when told that his engine burnt twenty-one times as much fuel as the prize engine.

With respect to the fixed steam-engines, the Society may congratulate itself upon the very successful result in the first attempt to introduce this implement into the show-yard and to the notice of agriculturists; the exhibitors brought several very effective engines of this class, and it is to be regretted that, in common with all first attempts, more satisfactory results could not be obtained in the experiments. Still enough was ascertained to enable the Judges to decide upon the merits of the implements, and at the next Meeting, if the Society determines upon having a suitable boiler for testing these engines, some good results will be obtained, as it is certain that exhibitors will bring better engines now they have had their attention directed to the matter.

The thrashing-machines exhibited were very numerous, and several of them displayed many judicious improvements. Those adapted for working by horse-power were worked by a steam-engine and having the horse-works attached.

As the power which they professed to require was accurately measured out to them, the work done will represent truly that which can be performed by the horses they require respectively.

Although it may be contended that driving these machines by the drum-spindle, and turning the horse-works through the agency of the barn-works, is not the best way of conducting the experiments, still it must be allowed to be preferable to working them by horses; and the additional business to be done occupied so much time, that the testing-machine used at Exeter could not be used at this Meeting; on the whole the experiments were very satisfactory.

In the tables of the Report of the Judges the time the machine required to do the work is given; and if the time so given is multiplied by the number of horses-power given to work the machine, the product will be a comparative number that will represent the quality of each machine, so far as power is concerned, in an inverse ratio to the magnitude of that number.

Thus in Class No. 1 (see Tables),

Garrett's machine of 2 horses power thrashed 60 sheaves in 7·1 minutes, and
Cambridge's ditto ditto in 13·5 minutes.

Minutes. Horses.
Then 7·1 × 2 = 14·2 horses, required to thrash 60 sheaves in one minute.
And 13·5 × 2 = 27 horses, required to thrash 60 sheaves in one minute.

Hence one machine took but little more than half the power to work it that the other required.

The column "Number on Counter" shows the number of revolutions the steam-engine made during each experiment; and that number being divided by 115 (the number of revolutions the engine made per minute), the quotient represents the *time* taken in the experiment.

Class No. 2.

	Minutes.		Horses.	
Garrett's prize machine	5·9	× 4 =	23·6	horses to thrash 100 sheaves in one minute.
Carpenter's . . .	10·7	× 4 =	42·8	horses to do the work in the same time.

The machines intended to be worked by steam-power, by Garrett and some others, were generally very good in their mechanical details; the arrangement of Messrs. Hornsby, of introducing a screw-elevator, enables them to keep their machines nearly as low in height as the ordinary machines, and the contrivance that enables them to pass all the refuse in the adverse direction to the cleaned corn is a great advantage.

In the machinery exhibited by Clayton and Co. there were many useful novelties. The performance of the various machines under trial, and the excellence of their workmanship, rendered the experiments more interesting on this than on any previous occasion.

The difference in the power required for working these machines, taking generally the extreme cases, was as follows:—

Class No. 3.

	Minutes.		Horses.	
Clayton, Shuttleworth, and Co., two prize machines . . .	8·2	× 6 =	49·2	horses to thrash 100 sheaves in one minute.
Smith's	11·6	× 5 =	58	horses to do the work in same time.

In winnowing-machines Hornsby and Son took the prize for their truly useful and effective implement. It is worth their consideration to inquire whether they should not make the machine something less in size; the time is fast approaching when the thrashing-machines generally will chaff their corn; and as the machine in its present form dresses the corn faster than it can be measured up, in the general way, a reduction in size might probably be an advantage; it would decidedly lessen the power required to turn the machine, which is now rather too heavy.

The chaff-cutting machine by Richmond and Chandler, for which they received the prize, is a highly ingenious and effective implement; it might probably be improved by raising the spindle a little, as the knives would then press upon the straw more flatly and not so much against the sides of the box as at present: the power required to work it is extremely light, when used for horse and steam power, and where the motion is continuous; but the two-pinioned machine by Cornes of Nantwich is the best machine for working by hand.

Several grinding-mills were exhibited, and the Judges' Reports show that the metal mill of Hurwood, the prize implement, did its work very well and with little power, and where the produce does not require reducing to flour it appears to be preferable to stones. Hence for splitting beans, or grinding any kind of grain for cattle or pigs, it is a very useful implement; but for grinding wheat, or reducing any kind of grain to very fine meal, stones would do better, while linseed, oats for horses, and malt are, perhaps, better crushed, without mealing, by rollers, as in Stanley's mill. Most of the metal mills do not feed so readily as could be desired, and a more regular feed would be given

to them by adopting the centrifugal feeder in the way it is frequently applied to corn-mills.

The tile-machines could be better compared at the next Meeting should the Society deem it right to define the diameter of the die that shall be used in the experiment. Perhaps a 2 inch pipe will be the best size that can be fixed upon ; such a regulation need not hinder the exhibitors from having other dies with them for showing the capabilities of their machines. The prize machine of Scraggs required only the fair power of one man to work it ; hence, had the exhibitors, whose machines worked easily, enlarged their " boxes " to such an extent as to have taken the power that could be fairly exerted by one man, the produce in work would have been greater and would have put them in a better position.

Before concluding these remarks it is necessary to notice that important implement, the reaping-machine, respecting which much has been written and said during the past season ; indeed it appears that the public are still undecided as to which of the rival principles (M'Cormick *v.* Hussey) should bear off the palm of superiority, which has even puzzled Judges of Implements on many occasions.

The cause of this indecision arises from the capability of the machine made on M'Cormick's principle to cut corn in a green or wet state with facility, while most machines made after Hussey's will cut corn only in a dry state : hence the awarding of the prize has more generally been the result of the state of the weather and crop at the time of experiment than of the intrinsic merit of the machines exhibited.

Garrett's prize reaping-machine at Lewes had an improvement in the form of knife, and, the day of trial being hot and dry, the machine performed very well.

The principle adopted by Garrett and Son in the form of their knives is a decided improvement upon the knives in the machine exhibited at the Great Exhibition, and may probably be carried still further ; as for instance, supposing that two knives were used in one machine, both the top and bottom ones being made very much thicker than those hitherto used, and bevelled off (like Garrett's) considerably, having their true and flat sides working upon the face of each other, the upper knife only moving, the staple-like projections through which the present knives work may be dispensed with, and the improved knives would cut corn or grasses readily whether they be wet and green, or dry and ripe : the lower knives being made so much stronger than usual would remove most obstacles from the path of the machines. The implement-makers will consider the hints here given, and may possibly turn them to their advantage and to the benefit of the farmer.

C. E. Amos.

APPENDIX TO IMPLEMENT REPORT.

A.

Report made to the Heads of the Royal Agricultural College, by the Gentlemen who were requested to examine the working of the rival Reaping Machines during the late trial.

Mr. Curtis Hayward, whose name appears first on the list, is the Chairman of the Court of Quarter Sessions for the county, and a gentleman of great agricultural experience from the neighbourhood of Gloucester. The other five are large tenant farmers near this town, and all well known as eminent practical men, of great experience and sound judgment, and well calculated to form an opinion and decide on the merits of the competing machines.

"We, the undersigned, having been requested by the authorities of the Royal Agricultural College to draw up a report expressing our opinion of the relative merits of the reaping machine of M'Cormick, exhibited by Messrs. Burgess and Key, and Hussey's machine, improved and manufactured by Messrs. Garrett and Son, as displayed in their performances upon the College farm, at Cirencester, during a succession of trials, which had extended over several days, and the cutting of upwards of 100 acres of different sorts of grain crops, report as follows:—

"That, upon examination of the fields in which the crops had been cut, we found the work to have been generally well and satisfactorily done by both machines, but the stubble left by Hussey's appeared, in all descriptions of grain, rather the neatest and most even. In each case it has been considered necessary to follow with the horse-rake, which had effectually cleared up all the waste, amounting, it was found, on the wheat stubble, to $2\frac{1}{2}$ bushels on 3 acres after M'Cormick's, and $3\frac{1}{2}$ after Garrett's machine. The wheat-fields we considered to have been favourable for the working of the machines, being generally level and clean, and to have presented fair average stand-up crops, in no places much laid, such as were likely to have produced in a fair yield about, probably, 30 bushels per acre, or rather more. The beans, a moderate crop, drilled 22 inches apart, had been cut principally by M'Cormick's machine, which had made very fair work; and the small portion upon which Hussey's had been tried was equally well done in both instances, leaving a more tidy stubble than the scythe, which had been applied to an adjoining portion of the crop. A crop of oats of about 20 acres, which we inspected, had been cut by the machines, and the oats were lying on the ground. The part cut by Hussey's appeared the cleanest and best work, but we considered either sufficiently well done. We made a careful inspection of the working of the two machines in a field of barley, laid down with clover and rye-grass. The barley was estimated to produce about 4 quarters per acre on the average, but not equal throughout, a portion being estimated at 5 quarters, while other parts were put only at 3 quarters, the clover being regular and very luxuriant, particularly where the barley was lightest. We considered this crop, from its nature, to be a severe trial to the machines, though the day being fine and the clover dry were points much in their favour. The work made by each of them was highly satisfactory, and where the barley stood up, in point of cutting, everything which could be desired, and, even where partially laid, not much to be found fault with. Hussey's cut the stubble lowest, and left it rather the more even of the two; but in more than one instance during our inspection it clogged, so as to require the machine to be stopped in order to clear the knives, an accident likely, in our opinion, to have occurred more frequently, and to have presented a serious obstruction, had the crop been wet, or even dew damp.

"From this objection M'Cormick's appeared to be free, as far as our observation went; the serrated cutters always clearing themselves, and its delivery was in this crop very superior; as the barley was laid out regularly by the one man on the machine conveniently in small heaps, with the ears generally upwards, while the two men who were employed in Hussey's to effect a lateral delivery, though apparently labouring more severely, could not deposit the barley so regularly, or in so good a form. The pace at which it was necessary for the horses to walk in order to secure the proper working of the machines appeared to us a most material feature in their relative claims. The horses which drew Hussey's machine were driven by a man riding on the near horse, and were kept going at a fast walk, which we estimated at nearly four miles per hour—certainly at a speed far exceeding the ordinary walk of regular cart-horses; and this speed appeared necessary to insure efficient working; a requirement which must be very distressing to heavy horses. We find indeed

complaints to be prevalent, as to this machine, that the work is too severe for a pair of horses for the whole day, which necessitates either more being applied or the horses being changed, which of course increases the expense. M'Cormick's, on the contrary, was driven by a man seated on the machine, at the ordinary pace of cart-horses (say $2\frac{1}{2}$ miles per hour), a rate at which a pair of horses might work a whole day, as at plough, and with as little distress; for this machine appears not only to be lighter in itself, but to work with more ease to the horses than the other, being so balanced as to throw a very slight pressure upon the horses' backs, while the weight on the pole of Hussey's is very considerable. We did not test particularly the quantity of work done by each machine in a given time; though, in the accounts recorded by Mr. Vallentine of the performances, it did not appear that there was much difference between them in this respect, each cutting between 5 and 6 roods per hour on the average. We consider, however, that if M'Cormick's machine, which clears a foot wider space than the other, is the lighter and less distressing to work, it must cut the greatest quantity, moving at that steady ordinary pace which we deem not only most desirable for the sake of the horses, but also for securing the continuous delivery of the sheaves with precision and regularity, and that any increase to be obtained by driving the horses beyond that speed would be dearly purchased. We are therefore of opinion that of the two machines thus tried, M'Cormick's has the advantage in lightness of draught, security of cutting, and clearing itself under adverse circumstances, and in the more convenient delivery of the sheaves. We think it right to state that M'Cormick's machine was under the management of Mr. Burgess, of the firm of Burgess and Key, the patentees, during the whole period of the trials, being worked by C. Stewart, their foreman; that the machine, having been sent down in a state unfit for use, required a considerable time and much alteration before it could be made to work properly, after which the only accident to which it seemed subject was the slipping off of the driving strap, which happened several times. This, however, Mr. Burgess states is prevented in all their new machines by placing a rim on the wheel. We were given to understand by Mr. Burgess that the machine we saw was an old one sent from America, and not of their own workmanship, to which they attribute the accidents which occurred; not having seen any of those made by Messrs. Burgess and Key, we cannot speak as to the efficient state in which they are sent out, but, unless they are free from the liability to such accidents as occurred at the commencement of these trials, we should consider such risks to be the most serious drawback to the machine. We may add also that we do not see any reason why the cost of this machine should be so much greater than Hussey's. The Hussey machine was purchased by the College from Garrett and Son, and was worked by farm-servants, under the direction of Mr. Vallentine, the able manager of the College farm, under whose superintendence and direction all these trials were conducted with great care, and at an expense of much time and attention, for which we consider the public are much indebted to him and to the College. A slight accident happened to this machine at the conclusion of our trials; but it was the first, we understood, which had occurred to it throughout the harvest, during which it has been pretty regularly employed.

"We cannot conclude our report without stating that we consider each of these machines to possess many merits, and to be capable, even in their present state, of doing much service to the farmer; but that they are both susceptible of very great improvement, especially in providing for the cutting and proper delivery of heavy and laid crops, and for working without the risk of wheels clogging in wet and soft ground; points in which they are as yet defective.

"J. Curtis Hayward.	"John Barton.
"William Slatter.	"John Lane.
"Thomas Vaisey.	"James Kearsey."

B.

Report of the Committee appointed by the Driffield Farmers' Club to Examine and Report on the comparative merits of several Reaping Machines, and on their applicability and usefulness in the neighbourhood.

Though your Committee had expected the following machines to be on the ground, viz. :—McCormick's, represented by Mr. W. S. McCormick (brother of the patentee); Hussey's, by Mr. Crosskill, of Beverley; another of Hussey's, by Messrs. Dray and Co.; and one by Mr. Wray, of Leeming; only the two former were submitted to their inspection, and, as the competition was confined to these two only, your Committee was able to bestow a more undivided attention on their respective merits than had a larger number competed.

The trial took place on Friday, the 13th instant, on a crop of wheat at Kelleythorpe; and had your Committee confined their report simply to the direction they received from the club, as to their superiority, and "which of the machines is best adapted for practical use in this district," their labours might have been brought to a close by stating that McCormick's machine was, in their opinion, superior to Hussey's in every respect; and that on all standing crops of grain, of whatever kind, and where the ground was tolerably even, McCormick's may be advantageously employed.

But, as your Committee are of opinion that it would be more satisfactory, not only to individual members of the club, and an act of justice to the owners and patrons of the successful machine, they beg to suggest the propriety of their being permitted to lay before the club, somewhat in detail, the reasons which led to the conclusion they have come to; and fearlessly state, notwithstanding adverse decisions, that McCormick's reaper, as regards power, speed, efficiency, and apparent durability, is far superior to Hussey's.

McCormick's machine is 6 feet wide, and Hussey's 5 feet: but, as it would be impossible always to keep up the cutting exactly to that width, they conceive that 6 inches less is all that can be calculated upon, and that at these widths, viz. 5½ feet and 4½ feet, and the horses moving at an average speed of 2½ miles an hour (a speed which your Committee would recommend), Hussey's machine would, in 5½ hours, cut exactly 7½ acres, while, in the same time, and with fully as little horse-power, McCormick's would do 9a. 0r. 26p. Another matter worthy of consideration is, that one man only is needed to drive the horses in McCormick's, the horses being yoked abreast, whilst two are necessary in Hussey's, having to draw in a line. McCormick's machine also possesses another advantage in having a wooden reel, which, without injury to the corn, materially assists the man who pulls away the sheaves, and gives him a better opportunity of adjusting their size.

But the greatest superiority of McCormick's machine over that of Hussey, which your Committee have to notice, is that the sheaves, when pulled off, are laid in such a way as not to impede its working, so that two men and two horses may move on uninterruptedly, leaving the rest of the labourers to be otherwise employed; while in Hussey's the sheaves are left behind, and a sufficient number of workmen is consequently required to remove them, so that the machine may go on. This your Committee need not point out as a grave objection, more especially when the crops are much mixed with clover or seeds, and it is desirable to let the sheaves remain unbound for a few days.

Your Committee are further of opinion that, from the violent reverberatory motion imparted to every part of Hussey's machine, durability is not to be expected, and that the form of the serrated cutters in McCormick's machine is far preferable to the deeply indented cutters in Hussey's, and that they will not nearly so often need renewing.

Your Committee now beg to state that the above conclusions have not been hastily adopted, and that their best and closest attention was given during the working of the machines; that they have no particular or party purpose to serve, their only object being to recommend that machine which they consider most

likely to benefit themselves and the farming community generally; and that, in giving a decided preference to McCormick's, their opinions were unanimous.

Thomas Hopper, Kelleythorpe.
Francis Jordan, Eastburn.
Caleb Angus, Driffield.
Thos. Craven, Driffield.
J. Staveley, North Dalton.

Driffield, August 17th, 1852.

C.

Report of the Jury appointed to award the Prize of Twenty Guineas offered by the Cleveland Agricultural Society for the best Reaping Machine.

The Jury have, in the first place, to observe that they have throughout the whole trial paid the greatest attention as well to the suggestions of the exhibitors as to those of the Committee of the Cleveland Agricultural Society.

The trial was to have commenced at 8 o'clock yesterday morning, but in consequence of a heavy rain, which ceased about 11, it did not begin till one, at which time the corn was rather damp and the ground somewhat stickey; the afternoon got out very fine, and the trial was continued till 7 o'clock P. M. The whole of the machines brought forward, except Mr. Hussey's, which had an accident during its transit to the trial-ground, had each two essays before the Jury.

The trial was resumed this morning at 7 o'clock A. M., and finished at noon. Mr. Hussey having repaired his machine, it was taken first and put through the same ordeal as those of the preceding day. The Jury then selected machines A, B, E, F, M, N, and O, the whole of which were put to the most severe and varied trial upon average crops of wheat and oats; part of the wheat was laid, and the land, although drained, was by no means level. The Jury, after timing and measuring the operations of the different machines, working them under a variety of circumstances, and balancing their merits and demerits, have come to a decision by a majority of eight to two that Machine E, manufactured by Messrs. R. Garrett and Son, of Saxmundham, Suffolk, and exhibited by Mr. John Palmer (their agent), of Stockton-on-Tees, is entitled to the premium, and they are unanimous in their opinion that machine O, manufactured and exhibited by Mr. McCormick, of America, should be highly commended. And they also unanimously commend machine M, manufactured and exhibited by Messrs. Wm. Dray and Co., of Swan-lane, London. It is proper to add that one of the jurymen was of opinion that machines E and O were equal in merit, and that the Prize ought to be divided.

The Jury have to remark that they considered machines A and B, as exhibited respectively by their inventors and makers, Mr. D. Hussey, of Baltimore, America, and Mr. J. Wray, of Leeming, near Bedale, are deserving of their approbation, inasmuch as in some respects there was great ingenuity displayed in their construction. The Jury have had the satisfaction of hearing several of the exhibitors express their unqualified approbation of the manner in which the trial was conducted.

The Jury cannot conclude their Report without expressing their unanimous thanks to the President of the Cleveland Agricultural Society for the use of his crops on this occasion, which enabled them to make the trial the most lengthened and varied that has taken place since the introduction of the reaping machines into this country, and they beg further to add that the greatest praise is due to the large and respectable assembly on the ground to-day for the orderly manner in which they conducted themselves during the trial.

(Signed) John Peirson, Foreman.

Gisborough, August 26th, 1852.

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue. Stand.	Article.	Price. £.	s.	d.
Ploughs.						
1. To Ransomes and Sims, of Ipswich, for their New Patent Iron Plough, with Two Wheels, for general purposes, marked R C; invented, improved, and manufactured by the exhibitors	£7	73	15	3	16	0
2. To William Busby, of Newton-le-Willows, near Bedale, Yorkshire, for his Two-wheeled Plough for Deep Ploughing; invented, improved, and manufactured by the exhibitor	£7	47	5	4	10	0
3. To Ransomes and Sims, of Ipswich, for their Patent Iron One-Way Lowcock's Plough, with Two Wheels and Skim Coulters, marked L P; invented by Henry Lowcock of Westerland; improved and manufactured by the exhibitors	£7	73	19	6	0	0
4. To Thomas Glover, of Thrussington, near Leicester, for his Turf and Stubble Paring Plough; invented, improved, and manufactured by the exhibitor	£5	10	1	5	10	0
Subsoil Pulverizer.						
5. To J. Gray and Co., of Uddingston, near Glasgow, N. B., for their Parallel Lever Subsoil Pulverizer; invented and manufactured by the exhibitors	£5	36	3	6	15	0
Drills.						
6. To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Drill for Corn and General Purposes; invented, improved, and manufactured by the exhibitors	£10	11	6	36	15	0
7. To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Patent Steerage Corn and Seed Drill, on an improved principle; invented, improved, and manufactured by the exhibitors.	£10	11	7	25	0	0
8. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Nine-row Lever Corn and Seed Drill for small occupations; invented and manufactured by the exhibitors	£5	54	10	16	0	0

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue.		
		Stand.	Article.	Price.
				£. s. d.
9. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Three-row economical small occupation Drill for Seed, &c., with manure on the flat or ridge; invented and manufactured by the exhibitors	£5	54	5	12 12 0
10. To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Patent Four-row Drill for Turnips or Mangold-Wurtzel Seed, with manure, on the flat; invented, improved, and manufactured by the exhibitors	£10	11	9	23 0 0
11. To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Two-row Patent Ridge Drill for Turnips or Mangold-Wurtzel Seed, with manure; invented, improved, and manufactured by the exhibitors	£10	11	10	24 0 0
12. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Patent Drop Drill for Turnips and other Seeds, with manure on the flat or ridge; invented, improved, and manufactured by the exhibitors	£10	54	4	24 10 0
MANURE DISTRIBUTOR.				
13. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Broadcast Manure Distributor; invented by H. E. Blyth, of Burnham, Norfolk, and manufactured by the exhibitors . .	£5	54	6	14 14 0
STEAM ENGINES.				
14. To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Six Horse Power improved Patent Portable Steam Engine, applicable to threshing or other agricultural purposes; invented, improved, and manufactured by the exhibitors	£40	11	1	205 0 0
15. To Barrett, Exall, and Andrewes, of Katesgrove Iron Works, near Reading, for their Six Horse Power Portable Steam Engine, applicable to threshing or other agricultural purposes; invented and manufactured by the exhibitors	£20	72	1	190 0 0
14.* To Barrett, Exall, and Andrewes, of Katesgrove Iron Works, near Reading, for their Eight Horse Power Fixed Cylinder Engine, applicable to threshing or other agricultural purposes; invented and manufactured by the exhibitors	£20	72	3	156 0 0

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue.				
		Stand.	Article.	Price.		
				£.	*s.*	*d.*
15.* To Ransomes and Sims, of Ipswich, for their Seven Horse Power Horizontal Stationary Steam Engine, applicable to threshing or other agricultural purposes; invented, improved, and manufactured by the exhibitors	£10	73	48	185	0	0
THRESHING MACHINES.						
16. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Two Horse Power Portable Threshing Machine, for small occupations; invented and manufactured by the exhibitors . .	£10	54	15	36	0	0
17. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Four-horse Power Open-drum Threshing Machine, for larger occupations; invented and manufactured by the exhibitors . .	£20	54	16	56	0	0
18. To Clayton, Shuttleworth, and Co., of Stamp End Works, near Lincoln, for their registered combined portable Threshing, Straw-shaking, Riddling, and Winnowing Machines, to be driven by steam; invented, improved, and manufactured by the exhibitors	£20	6	9	70	0	0
19. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their fixed Threshing Machine, fitted with Straw-shaker, Screen, and Winnowing Apparatus, that will best prepare the corn for the finishing Dressing Machine, to be driven by Steam Power; invented, improved, and manufactured by the exhibitors	£20	54	18	65	0	0
20. To Clayton, Shuttleworth, and Co., of Stamp End Works, Lincoln, for their fixed Threshing Machine, with finishing Dressing Apparatus, which performed, in the opinion of the Judges and to their entire satisfaction, every operation of Threshing, Shaking the Straw, Dressing the Corn in the most perfect manner, and Weighing it into sacks . . Awarded at the Meeting of the Council in London, Aug. 4, 1852.	£10 and Silver Medal.	6	10	180	0	0
CORN-DRESSING MACHINE.						
20.* To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Patent Corn-dressing or Winnowing Machine; invented, improved, and manufactured by the exhibitors . . .	£10	11	5	13	10	0

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue.		
		Stand.	Article.	Price. £. s. d.
Mills.				
21. To George Hurwood, of Ipswich, for his Patent Metal Grinding Mill for breaking Agricultural Produce into fine Meal; invented by the exhibitor, and manufactured by Ransomes and Sims, of Ipswich . .	£10	74	1	20 0 0
22. To William Prockter Stanley, of Peterborough, for his Registered Roller Mill for Linseed and Corn Crushing; invented, improved, and manufactured by the exhibitor	£5	9	1	12 0 0
Chaff-cutters.				
23. To Richmond and Chandler, of Richmond Square, Salford, near Manchester, for their Registered Chaff-cutting Machine, to be worked by Horse or Steam power; invented, improved, and manufactured by the exhibitors	£10	22	7	9 0 0
24. To James Cornes, of Barbridge, near Namptwich, Cheshire, for his Chaff-cutting Machine with two Knives, to be worked by hand-power; invented by John Cornes, of Barbridge; improved and manufactured by the exhibitor	£5	48	6	11 10 0
Turnip-cutter.				
25. To Bernhard Samuelson (successor to the late James Gardner), of Banbury, Oxon, for his Patent Double-Action Turnip-cutter; invented by the late James Gardner, of Banbury; improved by Alexander Samuelson, of Banbury, and manufactured by the exhibitor	£5	5	1	11 10 0
Oil-cake Breaker.				
26. To Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Double Cake Breaking or Crushing Machine; invented, improved, and manufactured by the exhibitors	£5	11	16	7 0 0
One-horse Cart.				
27. To William Busby, of Newton-le-Willows, near Bedale, Yorkshire, for his One-horse Cart; invented by William Lister, of Dunsa Bank, near Richmond, Yorkshire; improved and manufactured by the exhibitor .	£10	47	1	11 10 0

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue.		
		Stand.	Article.	Price.
				£. s. d.
Light Waggons.				
28. To William Crosskill, of the Beverley Iron Works, near Beverley, Yorkshire, for his Pair-horse Improved Waggon; invented, improved, and manufactured by the exhibitor	£5	1	13	24 14 0
28* To William Ball, of Rothwell, near Kettering, Northamptonshire, for his Light Waggon for two Horses; invented, improved, and manufactured by the exhibitor . .	£5	40	8	25 0 0
Resolution of Council, Aug. 4, 1852. "That the Prize of £10 offered for the best light Waggon for general purposes should be divided between Mr. Crosskill and Mr. W. Ball; the Judges, in accordance with their 3rd instruction, having specially reported to the Council their opinion that, in the competition for that Prize, the respective Waggons of those exhibitors were the two best in that department, and possessed equal merit."				
Drain-tile or Pipe-Machine.				
29. To Thomas Scragg, of Calveley, near Tarporley, Cheshire, for his Single-Action Machine for making Draining Pipes or Tiles; invented, improved, and manufactured by the exhibitor	£20	46	1	16 0 0
Draining Tools.				
30. To Mapplebeck and Lowe, of Birmingham, for their set of Bright Draining Tools; invented by Josiah Parkes, of London; and their set of Bright Draining Tools for Clay Lands; both sets manufactured by W. A. Lyndon, of Birmingham	£3	37	32 36	1 17 0 1 12 0
Harrows.				
31. To William Williams, of Bedford, for his set of Patent Four-beam Diagonal Iron Heavy Harrows; invented by Samuel Taylor, of Cotton End; improved and manufactured by the exhibitor	£5	63	4	5 0 0
32. To James and Frederick Howard, of Bedford, for their set of New Patent Jointed Light Harrows, with Whippletree; invented by James Howard and William Armstrong, of Bedford, and manufactured by the exhibitors . .	£5	30	18	3 15

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue.				
		Stand.	Article.	Price.		
				£.	s.	d.
SCARIFIERS.						
33. To Ransomes and Sims, of Ipswich, for their Biddell's Patent Wrought Iron Scarifier, Grubber, or Cultivator; invented by Arthur Biddell, of Ipswich; improved and manufactured by the exhibitors . . .	£10	73	37	18	0	0
34. To Charles Hart, of Wantage, for his Two-Horse Scarifier and Skim Plough; invented and manufactured by the exhibitor . .	£5	50	4	6	6	0
HORSE-HOES.						
35. To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Patent Horse-Hoe on the Flat, No. 5; invented, improved, and manufactured by the exhibitors	£10	54	13	16	0	0
36. To James and Frederick Howard, of Bedford, for their Improved Iron Horse-Hoe on the Ridge; invented and manufactured by the exhibitors	£5	30	25	2	7	6
HORSE-RAKE.						
37. To James and Frederick Howard, of Bedford, for their Patent Horse Drag Rake; invented and manufactured by the exhibitors	£5	30	27	6	15	0
GORSE-BRUISER.						
39. To Barrett, Exall, and Andrewes, of Katesgrove Iron Works, near Reading, for their Gorse-bruising Machine; invented and manufactured by the exhibitors . .	£5	72	29	26	12	0
STEAMING APPARATUS.						
40. To William Prockter Stanley, of Peterborough, for his registered Farmer's Steaming Apparatus for Cooking Food for Cattle, &c.; invented, improved, and manufactured by the exhibitor	£5	9	6	14	15	0
DYNAMOMETER.						
41. To Edward Hammond Bentall, of Heybridge, near Maldon, Essex, for his Self-computing Dynamometer, especially applicable to the traction of Ploughs; invented and manufactured by the exhibitor . .	£5	18	24	25	0	0

AWARDS.

Description of Implement and Name of Exhibitor.	Prize.	Reference to Catalogue. Stand.	Article.	Price. £. s. d.
42. Miscellaneous Awards and Essential Improvements.				
To Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their American Reaping Machine; invented by Obed Hussey, of Baltimore, U. S.; improved and manufactured by the exhibitors . . .	Silver Medal.	54	32	18 10 0
To Ransomes and Sims, of Ipswich, for their Patent Double Mill for Horse-power for Beans and Oats; invented, improved, and manufactured by the exhibitors	Silver Medal.	73	67	15 13 6
To James and Frederick Howard, of Bedford, for their improvements in Plough-Wheels, as exhibited in their Iron Plough marked X X X; invented and manufactured by the exhibitors	Silver Medal.	30	2	4 4 0
To Tasker and Fowle, of Waterloo Iron Works Andover, Hampshire, for their set of Well Machinery for Drawing Water, with Iron Cistern and Self-acting Tipping Apparatus; invented and manufactured by the exhibitors	Silver Medal.	17	2	19 12 6
To Burgess and Key, of 103, Newgate Street, London, for their Digging Forks and Farm Tools; invented by John Parkes, of Birmingham, and manufactured by Winter and Sons, of Birmingham	Silver Medal.	64	83, 84, 85, 86, 88	0 2 6 to 0 6 6
43 and 44, No Award.				

COMMENDATIONS.

Plough.				
Edward Hammond Bentall, of Heybridge, near Maldon, Essex, for his Patent Iron Beam Broadshare and Subsoil Plough Cultivator, and Scarifier, combined in one implement; invented and manufactured by the exhibitor	Highly commended.	18	1	6 6 0
Harrows.				
Henry Kearsley, of Ripon, Yorkshire, for his Norwegian Harrow; invented and manufactured by the exhibitor	Highly commended.	45	3	15 0 0
John Holmes and Son, of Norwich, for their One-Horse Lever Seed Harrow; invented and manufactured by the exhibitors . .	Commended.	60	9	4 10 0

COMMENDATIONS.

Description of Implement and Name of Exhibitor.	Commendation.	Reference to Catalogue.		
		Stand.	Article.	Price.
				£. s. d.
Drills.				
Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Drill for General Purposes; improved and manufactured by the exhibitors . . .	Highly commended.	54	1	35 12 6
Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Drill for Turnips and Mangold-Wurtzel, with manure on the ridge; improved and manufactured by the exhibitors . . .	Highly commended.	54	3	21 15 0
Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Ten-row Lever Corn and Seed Drill; improved and manufactured by the exhibitors . .	Highly commended.	54	9	26 8 0
Flax Seeding Machine.				
William Dray and Co., of Swan Lane, London, for their Flax Seeding Machine; invented and manufactured by Richard Robinson, of Belfast	Commended.	44	73	15 15 0
Farm Tools.				
Mapplebeck and Lowe, of Birmingham, for their set of Steel American Digging Forks, manufactured by W. A. Lyndon, of Birmingham, and a set of Farm Labourers' Tools, manufactured by Hunt and Co., of Birmingham .	Highly commended.	37	39 52	1 2 9 1 0 0
Reaping Machine.				
William Crosskill, of the Beverley Iron-Works, near Beverley, Yorkshire, for his American Reaping Machine; invented by Obed Hussey, of Baltimore, U. S.; improved and manufactured by the exhibitor	Highly commended.	1	5	18 0 0
Haymaking Machine.				
Smith and Ashby, of Stamford, Lincolnshire, for their Patent Improved Double-Action Haymaker, on their Patent Wrought-Iron Wheels; invented, improved, and manufactured by the exhibitors	Commended.	55	1	14 14 0
Steam Engines.				
Clayton, Shuttleworth, and Co., of Lincoln, for their Six-horse Power Portable Steam Engine; improved and manufactured by the exhibitors	Highly commended.	6	4	195 0 0

COMMENDATIONS.

Description of Implement and Name of Exhibitor.	Commendation.	Reference to Catalogue.				
		Stand.	Article.	Price.		
				£.	s.	d.
Richard Garrett and Son, of Leiston Works, near Saxmundham, Suffolk, for their Six-horse Power Portable Steam Engine; improved and manufactured by the exhibitors.	Highly commended.	54	20	200	0	0
Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Four-Horse Power improved Patent Portable Steam Engine; invented, improved, and manufactured by the exhibitors . .	Highly commended.	11	2	165	0	0
Richard Hornsby and Son, of Spittlegate Iron Works, near Grantham, Lincolnshire, for their Eight-horse Power Horizontal Fixture Steam Engine; invented, improved, and manufactured by the exhibitors . .	Highly commended.	11	3	192	0	0
Clayton, Shuttleworth, and Co., of Lincoln, for their Four-Horse Power Portable Steam Engine; improved and manufactured by the exhibitors	Commended.	6	2	155	0	0
John Eaton, of Woodford, near Thrapstone, Northamptonshire, for his Six-Horse Power Portable Steam Engine; invented and manufactured by William Batley, of Bridge Street Works, Northampton . . .	Commended.	61	1	150	0	0
Ransomes and Sims, of Ipswich, for their Six-Horse Power Portable Steam Engine; invented, improved, and manufactured by the exhibitors	Commended.	73	44	210	0	0
Tuxford and Sons, of Boston, Lincolnshire, for their Four-Horse Power Patent Portable Housed Steam Engine; invented, improved, and manufactured by the exhibitors . .	Commended.	56	2	165	0	0
MISCELLANEOUS.						
Barnard and Bishop, of Norwich, for their Cast-iron Window Frame and Fastener; invented and manufactured by the exhibitors . .	Highly commended.	20	.65	0	12	0
Edward Hill and Co., of Brierly Hill Iron Works, near Dudley, for their Patent Weighing Machine; invented and manufactured by Day and Co., of Birmingham . . .	Highly commended.	59	21	5	17	6
Richard Read, of No. 35, Regent Circus, Piccadilly, London, for his Patent Injecting Instrument and Tube, complete, for Horses, Cattle, &c.; invented by the late John Read; improved and manufactured by the exhibitor	Highly commended.	32	5	2	10	0

COMMENDATIONS.

Description of Implement and Name of Exhibitor.	Commendation.	Reference to Catalogue.				
		Stand.	Article.	Price.		
				£.	s.	d.
Henry Attwood Thompson, of Lewes, for his Eccentric Lever Hinges for Gates; manufactured by the exhibitor . . .	Highly commended.	77	243			
Burgess and Key, of 103, Newgate Street, London, for their Patent American Churn; invented by C. J. Anthony, of Pittsburgh, U. S., and manufactured by the exhibitors .	Commended.	64	28	2	4	0
Joshua Cooch, of Harleston, near Northamton, for his Patent Sackholder; invented by Henry Gilbert, of St. Leonards-on-the-Sea; improved and manufactured by the exhibitor	Commended.	23	8	1	3	0
Cottam and Hallen, of Winsley Street, London, for their Odometer or Land Measure; invented by George Cottam, of Winsley Street, and manufactured by the exhibitors . .	Commended.	35	38	2	12	6
William Crosskill, of the Beverley Iron Works, near Beverley, Yorkshire, for his Archimedean Root Washer; invented by Captain Carr, late of Tüschenbach; improved and manufactured by the exhibitor . .	Commended.	1	33	4	10	0
Edward Hill and Co., of Brierly Hill Iron Works, near Dudley, for their Wrought-iron Field-Gate; invented and manufactured by the exhibitors	Commended.	59	24	1	1	0
Edward Hill and Co., of Brierly Hill Iron Works, near Dudley, for their Wrought-iron Sheep-feeding Hurdle; invented and manufactured by the exhibitors . . .	Commended.	59	44	0	4	0
Ransomes and Sims, of Ipswich, for their set of Patent Trussed Iron Whippletrees; invented, improved, and manufactured by the exhibitors	Commended.	73	36	0	17	0
Richard Read, of No. 35, Regent Circus, Piccadilly, London, for his Patent Garden Engine; invented, improved, and manufactured by the exhibitor	Commended.	32	8	2	12	6
John Smith, of Uxbridge, for his Cylindrical Gravel Screen; invented by A. K. Smith, of Exminster; manufactured by the exhibitor .	Commended.	57	15	6	6	0
Henry Attwood Thompson, of Lewes, for his set of Wrought-steel Waggon Hames; manufactured by the exhibitor . . .	Commended.	77	162	0	18	

JUDGES.

W. Owen, Rotherham.	R. Beman, Moreton.
C. J. Carr, Belper.	W. Shaw, Far Cotton.
O. Wallis, Overstone Grange.	T. Hawkins, Assington Moor.
T. P. Outhwaite, Bainesse.	J. H. Nalder, Alvescot.
T. Scott, Broom Close.	W. Lister, Dunsa Banks.

CONSULTING ENGINEER.

C. E. Amos, Grove, Southwark.

XV.—*Experiments on Top-dressing Grass-land in Windsor Great Park.*

[Communicated by order of H.R.H. the PRINCE ALBERT.]

THE land marked I. (see p. 348) was enclosed from open pasture and cropped for hay, for the first time. The whole land so enclosed had received during the winter about twelve loads per acre of deer-pen manure, valued at 2*s.* per load. This manure seemed never to have produced any effect, in consequence of the long drought succeeding its application; and though its value ought to be stated against the crop, when considered generally, it has not been taken into account in the above statement, which is intended to show a comparison between land under two artificial manures, and land of the same description without them.

The land marked II. (p. 348) was a portion of a meadow, which has long been cropped for hay every year. This land received no other treatment than the application of the artificial manures.

From the above statement the benefit resulting from liberal top-dressing of grass is apparent. The aftermath on all the top-dressed land was also superior to that on the rest of the field, but no difference could be seen betwixt the two sorts experimented with. On the application of guano there seems to be considerably the greatest profit; but as experiments have been tried in other localities in which the nitrate of soda has had the superiority, the explanation of the difference in the effects produced must be sought for in some peculiarity of the soil. In both cases stated above, the soil and subsoil consist of clay, not very tenacious.

It is believed that the difference in the produce of the dressed and the undressed land is greater than may be expected in ordinary seasons, in consequence of the weather and other circumstances having been exceedingly favourable for the application of the manures. No rain had fallen, and there had been constant drying easterly winds from February till the 22nd May, the day of application, and consequently the grass had made no growth whatever. The manures, therefore, on being applied, came immediately into contact with the roots, and on the 26th May genial rains commenced, which continued almost without interruption till the day of cutting. The surrounding grass seemed never to make a start all the season, which the smallness of the crop will show, while the top-dressed land improved daily.

F. H. SEYMOUR, Deputy Ranger.
W. MENZIES, Deputy Surveyor.

Windsor Great Park,
22nd Oct. 1852.

STATEMENT showing the Result of Experiments on Grass, in Windsor Great Park, with Artificial Manures, 1852.

and Experimented upon.	Quantity of Top Dressing.	Cost per Acre.	Date of Top Dressing.	Weather during the Season.	Date of Cutting.	Produce per Acre.	Value at £3 per Load of 18 cwt.	Produce of surrounding Acres.	Value at £3 per Load.	Balance per Acre in favour of Top-Dressed Land.
		£. s. d.				cwt. qrs. lbs.	£. s. d.	cwt. qrs. lbs.	£. s. d.	£. s. d.
I. *High Undrained Land.*				Dry weather with easterly winds from middle of February to 26th of May. From that to the 6th of July heavy rains with warm weather.						
One Acre with Guano . .	2 cwt.	1 4 8	May 22		July 22	30 3 4	5 2 6	8 0 0	1 6 8	3 15 10
One Acre with Nitrate of Soda	2 cwt.	1 17 10	,,		,,	29 2 0	4 18 4	8 0 0	1 6 8	3 11 8
II. *Low-lying Meadow Land.*										
One Acre with Guano . .	2 cwt.	1 4 8	,,		July 16	27 3 0	4 12 6	9 0 0	1 10 0	3 2 6
One Acre with Nitrate of Soda	2 cwt.	1 17 10	,,		,,	25 0 0	4 3 4	9 0 0	1 10 0	2 13 4

XVI.—*On the Source and Supply of Cubic Saltpetre, Salitre, or Nitrate of Soda, and its Use in Small Quantities as a Restorative to Corn Crops.* By Ph. Pusey.

Last spring finding that about ten acres of barley, sown very early, that is, in February, had suffered severely by frosts unusually sharp for the season, I determined to try the experiment of applying as a restorative some nitrate of soda, but to use it, as the land was in good order, in a much smaller dose than was ever given before, 42 lbs. only per acre. It was accompanied with twice the quantity, 84 lbs., of common salt, which does not act as a manure, at least not on this land, yet seems necessary for correcting the luxuriant vegetation caused by the nitrate. A long strip (perhaps half an acre) was left undressed on one side to serve as a test. Small as was the dose, it acted immediately, for the barley so treated soon recovered its colour; and acted thoroughly, for until harvest the barley stood half a foot higher than on the undressed portion. The result on threshing out was most satisfactory, for, while the undressed portion gave only 40 bushels, the remainder, though so gently treated, yielded 47 bushels per acre. The cost of the dressing was, 6*s.* for the nitrate, 4*d.* for the salt; 6*s.* 4*d.* in all: the value of the seven bushels gained was 26*s.*, and the profit, therefore, 300 per cent. Indeed, I might justly assume a yet larger profit, for, contrary to former experiments with nitrate, the nitrated corn was superior to the unnitrated in quality also, to the amount of about 2*s.* a quarter, which would give a further profit of 10*s.* on the other forty bushels, or a total return of 36*s.* per acre for an outlay of 6*s.* 4*d.*, to say nothing of the straw, which might cover the trifling labour. It will be admitted, that this at least was no garden experiment, being a fair-sized trial upon a whole ten-acre field.

The result was beyond my own expectations: and not the least curious question on the action of the manure is the question, how so small a quantity of any salt could be spread equably, sown by hand as it was, or by any machinery even, so as to act uniformly upon the entire crop. Of the quantity used the weight gives of course no distinct notion, but I find that 42 lbs. weight of nitrate are not more than will three times fill a man's hat, and certainly it is marvellous that three hatfuls of any substance should increase so much and so regularly the corn upon a whole acre of land. Even the acre, however, does not present itself as a familiar measure to any but practical farmers. It will be useful, therefore, to take a further illustration. St. James's Park contains, I believe, 46 acres. If that entire space from Buckingham Palace to the Horse-Guards, including on each side the Mall and the Birdcage-walk, were cropped with barley, one

small one-horse cart-load (17 cwts.) of nitrate would (under the circumstances of the experiment above described) increase the yield by 80 sacks, or eight cartloads of grain. I may be excused for dwelling on this disproportion of cause to effect, because, even in agriculture, we are now so habituated to the wonders of science, that our minds become blunted, and, which is material, less ready to enlist those marvels practically in our own service. But if our fathers, at the opening of this century only, had heard that, with one cartload of a new powder, and two cartloads of salt to restrain its vigour, an effect could be produced which would have cost them certainly *four hundred* cartloads of dung, they would have been as much surprised as by learning that the journey from London to Oxford, instead of seven, would occupy little more than one hour. Evidently, then, we too in agriculture have found a new power of our own, scarcely inferior to steam in mechanics; and though, like steam, it may cost us time to gain certainty in its use, we must no more shrink from testing its qualities than we would discard the service of fire or of wine, because those mighty stimulants also of body or mind become fatal, if applied in excess.

It will be worth while, therefore, to inquire into the qualities of nitre, and may be interesting to trace out the first glimmerings of our acquaintance with its influence on vegetation. So early as in the Georgics, nitre is said to be used by the peasants round Mantua for steeping beans before sowing that crop. But an Englishman, in the days of Charles I., the accomplished and gallant royalist Sir Kenelm Digby, was the first who by direct experiment ascertained that barley watered with a weak solution of saltpetre grew very luxuriantly. Again, under Charles II., the classic writer on English country life, Evelyn,* recommended that 3 lbs. of saltpetre should be dissolved in 15 gallons of water, and then mixed with earth for a top-dressing. Yet the practice did not take root, for I find no renewed mention of saltpetre until 1825 and 1829, when a few trials of it were once more made, and with success. But the price was too high for its profitable application as a manure. Fortunately, just as science became ready to prove the agricultural efficiency of nitre, widening commerce opened to us a fresh source of supply by bringing a new kind from the plains of Peru—*cubic* saltpetre, which cannot be used for the old object, the fabrication of gunpowder, but is even richer, as will be shown presently, than common saltpetre, for the peaceful purposes of the farmer.

The old nitre is quoted now at 29*l.* per ton; the new, or cubic, nitre, at 16*l.*, little more than one-half, with a prospect, too, as I

* For this reference, as well as the former, I am indebted to Mr. Cuthbert Johnson's work on Fertilizers, p. 346.

hope to show, of future reduction. For the old nitre is either prepared artificially, or is gathered as it grows in a light efflorescence on the ground's surface in Spain, Egypt, and India; but the cubic nitre of Peru is found ready piled in beds several feet thick, throughout a long tract of country. In order to ascertain how far the sources of supply may allow a further diminution of price, I have carefully consulted all the authentic statements within my reach. The accounts of this nitre-bearing district have been hitherto rather vague, for the country was almost unknown; but at last we have an authentic description* of this extraordinary region from an eye-witness, Mr. Bollaert, who, having resided there many years, has minutely depicted it in a memoir and survey just published by the Geographical Society.

Peru is well known to be a narrow tract looking down westward on the Pacific, and up to the lofty chain of the Andes eastward. Of this strip, many hundred miles long, the most arid portion is the southern, and here is the province of Tarapaca, of which the chief port is Iquique. This port is guarded by an island once covered with guano, whence that manure was formerly called Guano de Iquique, though many islands equally rich, but less celebrated, stretch northward along the desert shore. Mr. Bollaert tells us that "there is neither wood, water, nor vegetation here. Most of the water is brought by sea from Pisagua, 45 miles to the north. During three years' residence at Iquique he only once saw a slight shower of rain, barely sufficient to lay the dust." This marvellous dryness, I may observe, has been of late thoroughly explained by Meteorology, which has at last laid down some general laws for the differences of climate. One of these laws is, that wind rising from the sea-level, and passing over a mountain ridge, becomes colder, is capable therefore of containing less invisible moisture, parts with that moisture as rain, and descends on the other side of the range dried like a sponge that has been squeezed. The Andes, once supposed to be the loftiest ridge in the world, dry the air thoroughly. The Himalayas, now found to be higher, for the same reason render Thibet a pre-eminently arid country. But Thibet receives other gales besides those from the south over the Himalayas. Peru is within the range of the trade-winds, which blow all the year round in one changeless sweep across the Southern Atlantic, and so pass the Andes. Hence, as Mons. Guiot † says, in his 'Physical Geography,' "the coast of Peru, from the Equator to Chili, is scarcely ever refreshed by the rains of the ocean. Deprived of the vapours of the Atlantic by the chain of the Andes, these countries behold the vapours of the Pacific flit away with the trade-wind that

* Journal of the Royal Geographical Society, vol. xxi. p. 99.

† Guiot's Earth and Man, or Physical Geography, p. 128.

holds on its course to the westward, while no accidental breeze brings them back."

Striking inland from Iquique, you first ascend a slope of loose white sand 1000 feet high, and then cross "a low mountain range covered with large angular pieces of rock to which ages of solar heat have given a calcined appearance, some having crumbled into powder. Here is much salt of a variety called clinkers. They have at a distance the appearance of bones, and the scene is one of absolute sterility. Everything is of a dull brown colour, except the blueish range of the Andes in the distance covered with snow." The only vegetation, Darwin had told us, besides a few cacti, is lichen of two kinds lying unattached on the sand, and tinging it in places with a yellow hue; the projecting lumps of salt, he said, give the appearance of a country after snow before the last dirty patches have thawed.

Having traversed this range (here about 10 miles wide), we reach a great plain, the Pampa of Tamarugal; but though a flat tract, it is as high as Skiddaw, being 3000 feet above the sea-level. It stretches north and south at the foot of the gigantic Andes for 80 miles; and along its western border, therefore the side nearest the sea, lie the grounds we are in quest of. They are for the first time described accurately by Mr. Bollaert, and, as the details are important, these must be given in his own words:—

"The principal deposits of nitrate of soda yet known are found on the western side of the Pampa de Tamarugal, commencing immediately where the level plain ceases, and on the sides of some of the ravines running from the Pampa towards the coast, and in some of the hollows of the mountains. The nitrate has not been found nearer to the coast than 18 miles, and looks as if it gradually transferred itself into salt as it approached the coast. The oficinas, or refining works, are divided into northern and southern salitres; the old salitres being about the centre of the former, and La Nueva Noria that of the latter; there are in all about 100 oficinas.

"The nitrate deposits commence about Tiliviche, and extend S. near to Quilliagua, with interruptions of deposits of common salt. The nitrate caliche grounds vary in breadth; the average may be 500 yards, and in places 7 to 8 feet thick, and sometimes quite pure. In the ravines and hollows before mentioned the nitrate is found on their shelving sides; the hollows look like dried-up lakes, and are covered with salt 2 to 3 feet thick, and on the margins there is nitrate of soda, ofttimes going down to some depth: in others there is a hard crust upon it, occasionally 4 feet thick. The nitrate caliche found under this crust is in thin layers, and so solid and pure as to be sought for, although the expense of blasting is very great.

"There are several varieties of the nitrate of soda caliche, the following being the principal:—

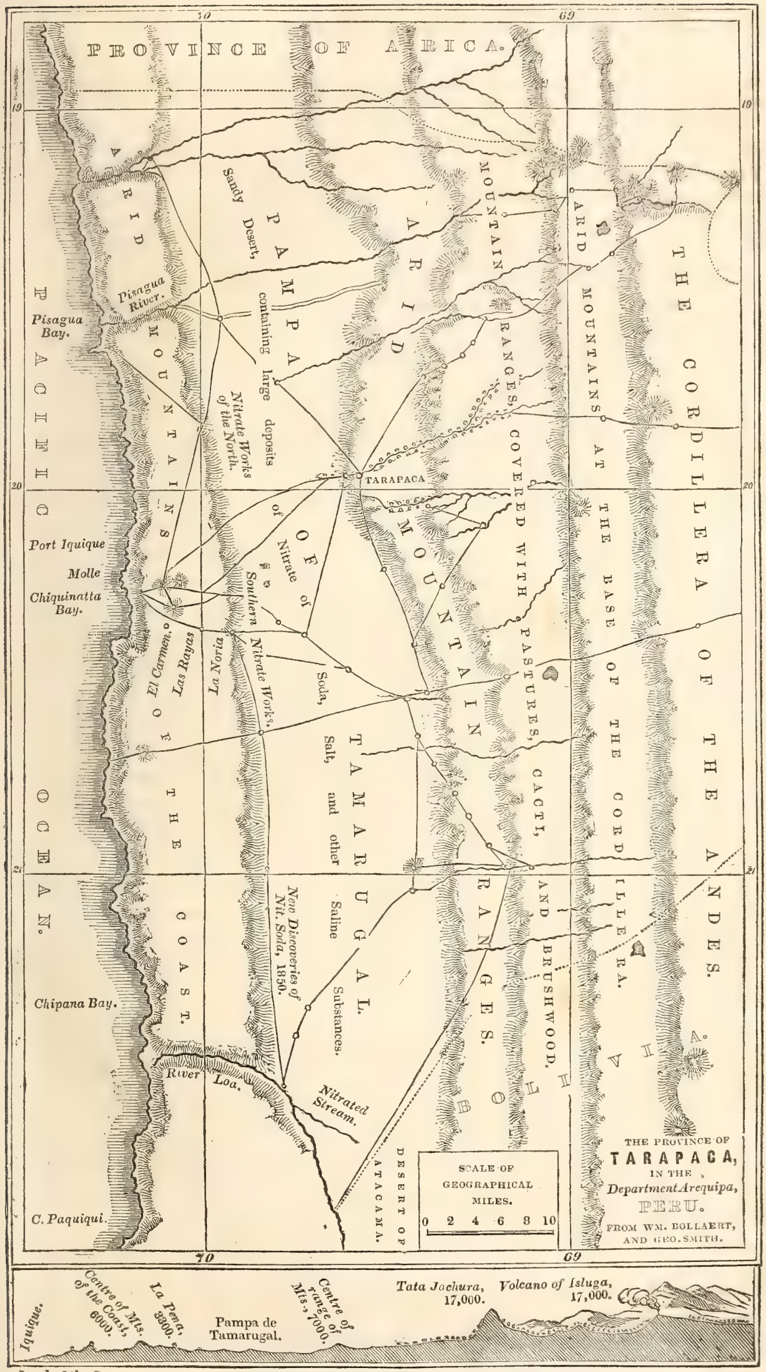
"1. White compact, containing 64 per cent.

"2. Yellow, occasioned by salts of iodine, 70 per cent.

"3. Grey compact, containing a little iron and a trace of iodine, 46 per cent.

"4. Grey crystalline, the most abundant variety, contains from 20 to 85 per cent., affording traces of iodine, with 1 to 8 per cent. of earthy matter.

"5. White crystalline: this resembles the refined nitrate. All these con-



SECTION FROM IQUIQUE TO VOLCANO OF ISLUGA.

tain common salt, sulphate and carbonate of soda, muriate of lime, and occasionally some borate of lime is found under the nitrate-beds.

"Fragments of shells have been noticed with and under the nitrate-beds. Mr. Blake mentions that 200 feet above the pampa (which is 3500 above the sea), near to Los Salitres del Porte, limestone containing shells rises from a bed consisting of pebbles and shells cemented together by salt and nitrate of soda. Part of the shells are decomposed, whilst others are perfect in form, and resemble those now still found living on the rocks in the inlets of the sea."

He brings us further the satisfactory news that

"The Pampa de Tamarugal contains sufficient nitrate for the consumption of Europe for ages; the desert of Atacama yields it; it has also been met with in the Andes and in the eastern plains."

Darwin, in the short account of his hasty visit, observed, as a geologist, on the nitrate band:—"The stratum follows the margin of a grand basin or plain, which manifestly must once have been either a lake or inland sea. The elevation at present is 3300 feet above the Pacific." The assertion will not startle those who are acquainted (and who is not?) with Sir Charles Lyell's great work, demonstrating that sea and land are ever gradually changing place, by an imperceptible rise or lowering of the land's level during the revolution of countless ages. This coast, indeed, is well known for signal upheavals in our own days. Southwards the famous earthquake of 1822, described by an eyewitness, Lady Callcott, raised the entire line of coast near Valparaiso four feet out of the sea; and again, in 1835, another earthquake lifted the island of St. Maria ten feet; while northwards, near Lima, is found the dry bed of a river once used for irrigation, the marks of cultivation being still visible on the side, but this bed now stands *fifty* feet higher than the present stream, which an earthquake has diverted into a new channel adjoining. Such a change having visibly happened since Peru has been inhabited, it is more easy to conceive, what no geologist indeed doubts, that the whole plain of Tamarugal has been raised from beneath the waves to its present height in the innumerable lapse of ages.

The occurrence therefore of common salt-beds on the deserted bottom of a sea which has slowly evaporated and finally disappeared would present no difficulty. Such superficial salt-beds indeed are by no means uncommon. They are found also near the Caspian Sea, and on the eastern coast of South America, as well as the western. In the neighbourhood of Iquique a similar bed is now actually being formed by the side of the ocean. Mr. Bollaert describes it thus:—

"In a plain near the Ansuelo rock at Iquique, and some 1000 yards from the shore, seawater is found near the surface. At the margin of the beach there is a sandy ridge or elevation, behind which the land is depressed. It is in this depressed part the seawater is found near the surface, where it readily evaporates, leaving layers of salt. Spring tides will add to this depo-

sition; and now let the land be upheaved, and we have as much salt as at Cesemeño."

But whence comes the nitrate of soda? Dr. Daubeny* answers the question as follows:—

"Wherever salt lakes occur, which become partially or wholly dried up during a part of the year, carbonate of soda will be formed from the decomposition of common salt. This I have observed myself on the sandy plains of Hungary, in the neighbourhood of Pesth. Now, if any circumstances should concur in such spots calculated to generate nitric acid, the latter by its stronger affinity for the alkali would take the place of the carbonic acid, and nitrate of soda would be the result. This however, being a deliquescent salt, would not accumulate on the surface, except in countries like Peru, remarkable for their extreme dryness."

This solution of the problem is singularly strengthened by the recent accounts of Mr. Bollaert, who finds in the nitrate-beds the very intermediate substance assumed by Dr. Daubeny, carbonate of soda, and again salt-beds changing at bottom into pure nitrate. It may confirm his view that nitrate is also found at the base of similar salt-beds near the Dead Sea.† Whether the nitric acid proceed from decayed animals, as he supposes, or spring from volcanic fumes, as I would conjecture, appears to me doubtful; but that this vast and valuable layer has been deposited from the ocean, and been afterwards in some way transformed into cubic nitre, seems now beyond doubt. I have been already, however, led too far into speculation by the singularity and value of the deposit, and by the novel information which has just reached us, but hope to be excused by the magnificence of the causes which have conspired to produce this unique phenomenon—the steady sweep of the trade-wind and the mountain-barrier which, drying that wind, has thus preserved a most deliquescent salt exposed on the soil's surface for years that are numberless—the series of successive earthquakes which have heaved up the bottom of the ocean and thus precipitated its brine—the volcanic exhalations which still issuing in flame from the neighbouring mountain-tops have perhaps by more tranquil passage through the pores of the soil converted that brine into a mineral treasure for other arts and for agriculture.

We now come to the practical questions—How has this mine of fruitfulness been hitherto worked, and can it be worked better hereafter, so as to yield its product at a cheaper rate? The existence of cubic saltpetre in Tarapaca has been known in Europe about a century, but none was sent to England until 1820; guano had been known for 200 years to be accumulated

* Lectures on Agriculture, p. 79.

† Lumps of nitre were scattered along the base (of the ridge of salt on the S.W. of the Dead Sea), of which we picked up several as large as the fist.—*Robinson's Palestine*, ii. p. 492.

in the same parched neighbourhood, yet did not reach Europe till some years later. In 1820, however, as Mr. Bollaert informs us, some nitrate was sent to England, but the duty being too high, *was thrown overboard.* Ten years afterwards, in 1830, a cargo was sent to the United States, but found unsaleable there; a part of it was therefore forwarded to Liverpool, but returned unsaleable from Liverpool also. Such is the risk of dealing in a new article; yet in the year following another cargo sold in England for 35*l.* per ton; and up to 1850 239,860 tons of the nitrate were exported from the port of Iquique alone, making a return of towards *five millions* sterling. The market-rate has since settled down to 17*l.* or 16*l.* per ton, but even at that figure the price, owing to the excessive cost of production, must be greatly too high. For, according to Mr. Darwin, the chief expense in producing it is the transfer from the quarry to the sea-coast. Now the distance as the crow flies is not more than 10 miles, and, by the circuitous track (road there is none, even for this large traffic), that traveller reached the works from the port, though mounted upon a mule, in a single day. The nitrate also is brought down on the backs of mules, and Mr. Darwin found the desert interval strewed with the bones and dried skins of the many beasts of burden which had perished on it from fatigue. The only living animal was the vulture, which preys on the carcases. Even with this barbarous mode of conveyance I cannot understand how transport for one day's journey can alone justify so high a price; when 14 gallons of water, more than a hundredweight, are carried in the same way to a neighbouring silver-mine, a distance of 22 miles, for 4*s.*, a small part of 16*s.* now charged on the hundredweight of nitrate. But of course a carriage-road would have been made years ago had not the country belonged to a race whose inertness neither the civilization of Europe at home, nor the enterprise of a new field in America, can overcome. It is singularly unfortunate that the only three great deposits of manure in the world should be in the keeping of Spaniards: for the phosphate bed of Estremadura, described by Dr. Daubeny, is almost as inaccessible as the Pampa of Tamarugal, while guano, though lying on the sea-shore of Peru, is doubled in price by monopoly of the government.

But it appears to me that a further large reduction might be made in the cost of nitrate when intended to be sold for manure. All the nitrate now sent to England goes through the process of purification, because it is chiefly used by chemical manufacturers, not by farmers. The process at the quarries, for they cannot be called mines, is as follows:*—" The rough nitrate of

* Mr. Bollaert, Journal of Geographical Society.

soda is broken into small pieces, put into boilers, water introduced, and the whole boiled; the nitrate is held in solution, whilst the earthy matter, salt, sulphates, &c., are separated, and fall to the bottom of the vessel: the saturated solution of nitrate is let into a reservoir, where it deposits any remaining earthy matter; the clear liquor is run into shallow troughs, exposed to the sun; crystallization takes place, containing only 2 to 3 per cent. of impurities, and it is then ready to be conveyed to the coast for exportation."

Now, inasmuch as there is no rain, neither is there firewood near the hundred refineries; consequently in these Peruvian deserts they employ as fuel English coals brought round Cape Horn to Iquique, and thence of course upon mules' backs to La Noria. But for agricultural purposes I cannot think that the nitrate need be refined at all. We have seen that the proportion of nitrate contained in the rough salt reaches 85 per cent., while the only impurities are salts, which might themselves be rather beneficial, and are certainly harmless to crops. The rough material lies on the surface, within a few miles of the shore, not near Iquique only, but along a wide range of coast. It may be dug like gravel, and I cannot see why it should not come to England for 6*l.* instead of 16*l.* per ton, as the price of the pure nitrate existing in this unrefined ore. A few miles of common cart-road are all that is wanted: if the country had happily belonged to men of the United States, there would have been a railroad from La Noria to Iquique already. Let us trust some merchant or some company will undertake the venture, which must at once, if successful, effect another desirable object, and greatly lower the price of guano, for happily this wide tract of nitrate-bed provided by nature is not capable of being monopolised, like the guano islands, by any Government of Peru. Nay, if that Government should feel called upon to interpose impediments, a rival source of nitrate exists in the contiguous desert of Atacama within the territory of Bolivia.

In saying that cubic nitre may compete with guano as a manure, I rely on the experiments made by Mr. Lawes, with his coadjutor Dr. Gilbert, upon his farm at Rothampstead, and I rejoice to see that these experiments, from which when they first appeared in our Journal I could not in justice withhold my own testimony, are now fully appreciated in Germany. Dr. Strumpf, in his Agricultural Chemistry,* published at Berlin, declares, with the readiness of his countrymen to recognise scientific merit in any quarter, that "Mr. Lawes has done more for the advance of agriculture than any government ever did, by obtaining a practical solution of the questions on the theory of manure,

* Fortschritte der Chemie in ihrer Anwendung auf Agricultur und Physiologie, von Dr. F. L. Strumpf. Berlin, 1853, p. 255.

and so on the one hand relieving the farmer from expensive delusions, on the other hand securing genuine discoveries against the mistrust of ignorance." In fact, these are not merely the best, but the sole reliable, series of experiments upon manures, and they have produced a great result in the discovery of the only fundamental truth we possess in agricultural chemistry, namely, that *Nitrogen is the element mainly required as manure on ordinary soils by our corn-crops.** Thus upon previously exhausted land at Rothampstead, 3 cwt. of salts of ammonia, applied for six successive years, raised the yield of wheat at the rate of nine bushels a-year, while 14 loads of dung raised it but by eleven bushels, that is by only two bushels more. If the unassisted nitrogen lagged somewhat behind the dung, thus proving that the soil could not fully supply the mineral constituents of the wheat-crop, this is quite immaterial for the purposes of common farming, since in common farming white crops are alternated with green ones—ammoniacal manures with phosphoric—and even in the fifth year's repetition at Rothampstead, the amount of yield marked no perceptible default of other ingredients, no failure in the ammonia.

This simple law explains the adoption of the multifarious substances which practice had taught those who went before us to employ. Dung used everywhere, sprats applied in Thanet, seaweed in the Lothians, rape-cake in Yorkshire, woollen rags in Berkshire (not half cotton rags as they are now), soot, horn-shavings—all these substances, however incongruous, and in later times Guano, Gas-water, Nitrate, agree in nothing else, but agree in this—that they contain Nitrogen, and, in as far as they so agree, are capable of increasing our corn-crops. If any one conversant with the theory of cultivation look back only ten years, he will see how great an advance it is to have established this principle, not as a conjecture only, but as an undeniable law. As with most discoveries in other sciences, our eminent chemists have all more or less anticipated the truth, but the ownership must be appropriated to him who has *proved* it, and Mr. Lawes has earned the high honour of establishing a principle of the same importance in scientific Agriculture that gravitation bears in Astronomy, or the circulation of the blood in Medicine.

The substance indeed which we are now considering was not experimented upon at Rothampstead, and in some degree differs from any that was used there, since nitrogenous substances may be divided for our present object into three classes,—first, those which contain ammonia (or urea convertible into ammonia),

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* Mr. Lawes by no means denies that mineral manures are sometimes useful, but he has proved that even then the ashes of the plant afford no safe indication of the manure to be applied.

as dung, soot, sulphate of ammonia; secondly, vegetable or animal organized substances, as seaweed or wool, which class was represented at Rothampstead by rape-cake; lastly, mineral combinations of nitric acid. Now, undoubtedly we could not be certain beforehand that such compounds with nitric acid would act on plants in the same manner as the former two, which contain nitrogen, either in ammonia, or in organic matter capable of producing ammonia. But facts prove that the nitrates, notwithstanding the acid form of their nitrogen, are no exception to the great law. For we have no less than three nitrates which act as fertilizers; first, nitrate of potash, the original saltpetre, used as manure partially a few years ago in this country. Its advantages are also known, as Professor Johnston acquaints us, to the hereditary gardeners of Bengal.

"The districts of Chaprah, Tirhoot, and Shahabad, near Patna, where a large proportion of the saltpetre sent from Bengal is produced, are considered the most fertile in Bengal, producing two, and sometimes three crops yearly. The natives of these districts, particularly a class called Quircas (hereditary gardeners), who cultivate the best land and produce the best crops, are in the habit of irrigating their fields with water from wells so strongly impregnated with saltpetre and other salts as to be brackish. . . . Grain-crops also grow most luxuriantly on lands yielding saltpetre, where there is enough of rain within a week or two after the seed is sown; *but if a drought follow the sowing, and continue for three weeks or a month, the leaf becomes yellow, and the crop fails.*" *

Thus the soil, it appears, is sometimes naturally fertilized by saltpetre; and since even this natural endowment occasionally proves prejudicial, we may learn to be more merciful if the means theoretically proposed by philosophers be not exempt from every shade of objection, nor safe from every accident of our varying climate. Secondly, the mortar of old walls is known to have a manuring power far beyond any virtue of the lime contained in it; now this mortar is in France the principal source of saltpetre, which is obtained by steeping the rubbish, and decomposing with potash the nitrates of lime and magnesia found dissolved in the steep-water. The nitrate of these earths also must therefore act as a fertilizer. Lastly, the activity of the soda-nitrate has been shown repeatedly in this Journal.

We may assume, therefore, that nitrates, notwithstanding their special form, fall under the general law of nitrogenous manures, and may proceed to compare cubic nitre with guano, as is natural from their similarity of application for top-dressing corn as well as from the probable competition in commerce between these two manures as sources of nitrogen. We find then chemically that the new nitre, though costing about half the price, contains more nitrogen by one-sixth than saltpetre, but, though costing

* Lectures on Agricultural Chemistry, p. 281.

half as much again as guano, scarcely exceeds that manure in contents of nitrogen:—*

	Nitrogen per cent.
Saltpetre	12·43
Cubic nitre	14·77
Guano	14·34

* Mr. Way has been so good as to calculate for me the relative amounts of nitrogen in these three substances as follows:—

Guano.

Ammonia consists of—

Nitrogen	14	(1 equivalent)
Hydrogen	3	(3 equivalents)
	17	

Consequently guano, which yields 17·41 of ammonia, contains 14·34 per cent. of nitrogen.

Cubic Nitre, or

Nitrate of Soda, consists of—

Nitric acid (1 equivalent)	54·0
Soda (1 equivalent)	31·3
	85·3

Consequently 100 parts of nitrate of soda contain—

Nitric acid	63·3
Soda	36·7
	100·0

Nitric Acid consists of—

Nitrogen (1 equivalent)	14·0
Oxygen (5 equivalents)	40·0
	54·0

As therefore 100 parts of nitrate of soda contain 63·3 parts of nitric acid, the percentage of *nitrogen* in nitrate of soda will be 16·41.

The above calculation refers to *pure* nitrate of soda. For average commercial nitrate of soda it will be fair to take off 10 per cent. for impurities and the admixture of other salts, and for accidental moisture.

From	16·41
Deduct one-tenth	1·64
	14·77

Which number fairly represents the nitrogen of 100 parts of commercial nitrate of soda.

Saltpetre, or

Nitrate of Potash.—100 parts of pure nitrate of potash consist of—

Potash	46·68
Nitric acid	53·32
	100·00

As therefore 100 parts of nitric acid contain 25·9 parts of nitrogen, the 53·32 parts of nitric acid in 100 of nitrate of potash will contain 13·81 *parts of nitrogen.*

Pure nitrate of potash therefore contains 13·81 per cent. nitrogen. Deduct 10 per cent. for the commercial nitrate, thus—

From	13·81
Take	1·38
And we have	12·43

as the percentage of nitrogen in commercial nitrate of potash.

The difference as against guano is insignificant; and since guano further contains phosphorus which is certainly, and potash which seems sometimes, useful to corn-crops, it is difficult to see why cubic nitre at 16*l.* should ever have been preferred to guano at 9*l.* by farmers who could purchase either. Still there must be some reason, since both are employed upon corn-land in England. Unfortunately we have very few comparative experiments between the two manures,—and what is more unlucky, those few, collected by Professor Johnston in his excellent lecture,* were chiefly made during a summer so dry that they only acted by chance. Such contradictory results as the following give us no information :—

Top-dressed with	Produce per Acre. Bushels of Wheat.	
Guano, 1 cwt.	46	Erskine, Renfrewshire.
Nitrate, 1 cwt.	54	
Undressed	44	
Guano, $1\frac{1}{4}$ cwt.	45	Seisdon, Worcestershire.
Nitrate, $1\frac{1}{4}$ cwt.	41	
Undressed	39	

The only later experiment upon corn which I am acquainted with is one made at this place, and published by me last year, in which a single cwt. of nitrate surpassed two cwts. of guano.†

	Bushels of Wheat.	Increase.
Undressed	21	
Guano, 2 cwt.	24	3
Nitrate, 1 cwt. with salt	$25\frac{1}{2}$	$4\frac{1}{2}$

This, however, was also made in a dry summer, and, though it was carefully made, I have no doubt that the proportion of increase is unfair towards the guano. In the absence, then, of full, direct, experimental comparison, we must have recourse to the best evidence on the respective powers of these two manures; and the result will, I trust, be found to warrant some minuteness of investigation. Now Mr. Lawes informs me, as the result of his long experience, that he would expect on the average from *one* cwt. of guano, not from *two* as in this trial, three bushels of wheat. But the increase from the Nitrate is also low. Taking again the best evidence, I have ascertained from an eminent agriculturist, the manager of Lord Leicester's farm, at Holkham, Mr. Keary, that in that neighbourhood, which has not lost the impress of Mr. Coke, cubic nitre is largely used, and gives an average increase of *six* bushels per acre for a dressing of from three quarters to an entire hundredweight. We may assume six bushels then as the product per cwt. of Nitrate on moderate land in fair order. On land in the highest condition it would give

* Johnston's Lectures on Agricultural Chemistry, p. 281.

† Journal, vol. xii., p. 202.

perhaps less, as was the case the year before last on Lord Leicester's own farm at Holkham.* On land out of condition it might even give more—it gave me last year upon ground purposely impoverished, *eight* bushels.† But if it be true, as it appears to be, that nitre yields six bushels, and guano only three bushels per cwt., though each contains nitrogen to the same amount, how is this unexpected conclusion to be accounted for? This question is also practically important, for two reasons. To reduce the price of guano is a matter of pressing interest, for last year 245,066 tons of guano were imported into this country, and sold to our farmers for more than *two millions* sterling, of which sum nearly *one million* is drawn from them by foreign monopoly, though that official monopoly does not unfortunately secure us in the quality of the supply, which appears to be adulterated at the fountain-head with plaster of Paris, sent out thither from Liverpool ;‡ yet we know no probable source of cheap *ammonia* as a substitute for that contained in guano. Again, the top-dressing of young corn is year by year more widely practised, and it greatly behoves us to ascertain which of the two substances we should employ for this special purpose. If guano be inferior for it to cubic nitre, one reason may be that the ammonia it contains is a *fugitive*, while nitrate is a *fixed* salt. Consequently in dry weather guano may produce no effect whatever on the actual crop, as I have myself experienced; and, being wasted by the wind, no effect afterwards. I may mention too, as it is in fact an experiment upon a large scale, that last spring, when I was preparing to apply the nitrate to my own frosted barley, I counselled a neighbour to try the same dressing. Though an excellent farmer, he adopted only half the advice, preferring guano as the *cheaper* manure. He could not perceive afterwards that the guano had produced the slightest effect on his barley, while the nitrate had so much benefited mine on the same soil and in the same season. Mr. Lawes, too, assures me that throughout his many experiments he has lost one-half of the ammonia contained in his guano, the corresponding nitrogen not re-appearing in the yield of grain and of straw. Nitrate, on the contrary, would lie safe on the surface beneath a scorching sun, and will then as we know act upon the following crop. On the other hand, in a rainy season, Nitrate will very likely, especially if applied in a full dose at once, be washed down too rapidly

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* Journal, vol. xiii., p. 201. † Journal, vol. xii., p. 203.

‡ "Four vessels recently sailed hence for guano stations, ballasted with gypsum, or plaster of Paris. This substance is intended for admixture with guano, and will enable parties to deliver from the vessel a nice-looking and light-coloured article." —*Liverpool Paper*. Professor Johnston's 'Elements of Agricultural Chemistry,' 6th ed., p. 234.

beyond the reach of the roots, and that *may* be the cause of its having been distanced by guano in the experiment made this year in Windsor Park,* which experiment, however, in any case, serves to prove the great benefit arising from either in a propitious season upon poor *grass*-lands. Now, in wet weather, the ammonia of guano, according to the discovery of Mr. Way, being converted within the soil into a *fixed* double salt, would remain within reach of the roots, incorporated with the soil, perfectly safe. There would seem, therefore, to be a balance of advantage in reference to weather between these two Peruvian manures, cubic nitre being more secure from loss by the sun, and guano least exposed to percolation from excessive showers. The latter danger, however, is the least threatening one in the usual season for top-dressing, March and April. Still we require many experiments before we can speak positively, and there will be some difficulty in making them, because nitrate, and guano too, act the most signally upon impoverished land, while the farms of our members, whether owners or tenants, will seldom be found in that state. But there is no shadow of doubt that nitrate is at least equal to guano as a top-dressing for corn; and since superphosphate is quite as wholesome as guano for turnips, we have the remedy in our own hands for abating the present exorbitant charge for guano, by diminishing its use until that charge be abated. Indeed, except for experiments, I have long given up the use of guano upon my own farm, because nitrate and superphosphate act with more certainty here, the one on corn, the other on turnips.

It has been proved, then, that nitrate, even at its present high price, can compete successfully with guano as a manure for our corn crops. In the improvement of my barley-crop last spring it may even be said to have answered the Society's desire, expressed by our premium of 1000*l.* for a manure equal to guano, to be sold at the price of 5*l.* instead of 9*l.* per ton; that is, 5*s.* instead of 9*s.* per cwt. For one cwt. of nitrate produced $18\frac{2}{3}$ bushels of barley, which, according to the usual proportion in the yield of the two crops, is equivalent to 14 bushels of wheat; but according to Mr. Lawes, 1 cwt. of guano, costing 9*s.*, produces 3 bushels of wheat; now an amount of barley equivalent

* It is right to mention that, besides this experiment, which stands in the preceding article, another comparative trial, made on the Duke of Somerset's property, also placed guano above nitrate for grass-land (Journal, x. 400). If this superiority do not arise from its endurance of rain, we must look for it in the other ingredients of guano—phosphorus, namely, and potash. Phosphorus, however, has failed repeatedly when applied to any grass-land but the Cheshire clay. But there are strong grounds for thinking that potash acts upon poor mossy pasture-land, to which land wood-ashes are commonly applied in Hampshire; and two cwt. of guano contain 16 lbs. of potash, according to Mr. Way's standard (Journal, x. 225).

to 3 bushels of wheat was in this instance yielded by a quantity of nitrate worth not 5*s*., but 3*s*. 4*d*. This profit is indeed beyond the average; but here are other instances in which nitrate has evinced extraordinary energy.

Crop.	Owner.	Nitrate per Acre.	Present Cost. *s.*	*d.*	Undressed Land. Bush.	Nitrated Land. Bush.	Increase. Bushels.
Barley . .	Hon. H. Wilson .	1 cwt.	16	6	18	32	14
Rye	Mr. Fleming . . .	160 lbs.	23	6	14	26	12
Wheat . . .	Mr. Calvert . . .	1 cwt.	16	6	25¾	37¾	12
Oats . . .	Mr. Newman . .	1 cwt.	16	6	40	60	20

These may be called happy accidents; but we must remember that the word accident, applied to Nature, only covers our own ignorance of her laws—an ignorance which, by careful experiment, we must hope with time to clear up: meanwhile we have already learnt a great deal. When this saltpetre was first introduced it was applied in large quantities, and occasionally even did mischief. Through the excessive stimulus the straw of wheat sometimes turned black-green, grew immoderately, and mildewed the grain. Sometimes these full doses, if administered in dry weather, scorched the young blade, as sheep's urine scorches grass upon a parched soil. Again, if much rain followed, the corn, shooting up too rapidly, was of course weakened, and the crop laid as if by a roller. From one or other of these three causes it now and then happened that at harvest nitre was found, while it had augmented the bulk of the straw, to have diminished the yield of good grain, and it was therefore almost given up, as wild and unmanageable; but means have been lately found to tame this intemperate vigour, as we first learned from Mr. Caird,* the 'Times' Commissioner, who describes the new method as follows:—

"At Holkham the whole of the young wheats, 280 acres in extent, have a top-dressing applied to them, in spring, of 6 stones of nitrate of soda mixed with 16 stones of salt to the acre.

"This quantity is applied in equal moieties at intervals of three weeks or a month, beginning early in March and ending about the 20th of April. It has been found in practice better to lay it on so than to apply it all at once. . . In top-dressing his wheat Mr. Overman uses 1 cwt. nitrate of soda mixed with 2 cwt. of common salt, applied in two dressings, as already described. . . On Sussex Farm Mr. Blyth follows the same system of top-dressing his wheat."

It was this last gentleman, Mr. Blyth, who first discovered the method of using nitre with safety.† If we thus add salt, which is known to brighten and strengthen the straw, administer moderate doses, and at some intervals, mixing the nitrate well with the salt,

* These letters have just been published under the title of 'English Agriculture;' and whoever wishes to acquaint himself with the practical variety of English farming should, above all, study that book.

† Mr. Blyth has also invented a machine for broadcasting the nitrate, which received our Society's prize this year at Lewes. Those, however, who are disinclined to purchase an implement can have the nitrate perfectly well spread by hand, as in common sowing.

so as to diffuse it more evenly—lastly, taking care if possible that the ground shall be rather moist when the mixture is sown broadcast—we may treat our crops with this powerful medicine in perfect security. Where feebleness of plant or poverty of soil exists, there it acts best: thus, Mr. Burgess, who seems to have been the first to employ nitrate for manure instead of saltpetre, informs us, in 1840, that he used it *when, from the wet season and the wireworm, the plant was nearly destroyed, and had above an average crop of wheat.** It is to be feared that in March next opportunities for trying this experiment will not be wanting. If the land be in high ridges and undrained, the ridges may escape injury and the hollows be almost bare. Then let the hollows be dressed in proportion to their requirements. According to the evidence we possess, there is no land which will not be benefited by nitrate, unless the very best or the most highly-farmed.† On such land every farmer is aware that it is dangerous to force wheat; but on the cold clays nitre is pre-eminently successful. Whoever has crossed the great Weald of Kent, Surrey, and Sussex, on his way to Folkstone or Brighton, must have observed the cold and sterile aspect of its hardbound yellow clays, nor do I know any district of England where skill seems less to have coped with the defects of nature; yet in this very Weald we find that nitrate gave to the farmers employing it *properly*, on an average 8 bushels per acre of wheat, and for oats a profit of 27*s.* to 30*s.* per acre,‡ which might be now 20*s.*; but even so reduced in amount *would be the whole rent of such land.* If so, the use of nitrate answers the question often asked—What can be done for our cold clays?—For why is it our cold English clays are so much compassionated? Simply because even when drained they are unable to grow root-crops for winter-feeding, and so to obtain nitrogen from stock consuming those crops. Cubic nitre then supplies their special deficiency. It will be equally opportune indeed to large tracts on the Continent also, where the want of demand for fresh meat depresses the soil's productiveness in the same manner—on the chalk hills of Picardy and the sand plains of Brandenburg. How much more if the desert of Tamarugal be laid open by some better conveyance than packmules, and the price of nitrate be reduced by one-half! Bones are not so potent a manure; yet they redeemed the Lincolnshire Heaths and Wolds. Nor is capital required for the purchase of a top-dressing like nitrate, the outlay

* Journal, ii. p. 132.

† I should mention, however, that in Lancashire, where rain is abundant, Mr. Garnett has not found the use of nitrate of soda, even conjoined with salt, perfectly safe, unless further combined with silicate of soda, or sown in the autumn. (See Mr. Garnett's letter, p. 367.)

‡ Journal, ii., p. 127.

on which returns in the crop as soon almost as, after three months' credit, it is paid to the dealer.

It is wonderful certainly to have found a mineral which, even at its present high price, yields us wheat at a cost of 24*s.* a quarter; and if cheapened, as it might apparently be, by one half, would of course yield it at 12*s.* a quarter. Thus, instead of three million quarters of wheat costing six millions sterling, we might import yearly 200,000 tons of nitrate (a less weight than we have already imported of guano in a single year), costing little more than three millions, or, if the price of nitrate were reduced to eight pounds, costing sixteen hundred thousand pounds only; and so our farmers might obtain from their own farms the whole foreign supply of wheat without labour and with but a few months' outlay of capital. This would indeed be an important result for the nation as well as for British farmers. I do not mean to say that no failures will yet occur before we obtain a complete mastery over this powerful substance; but I am confident that, as California has been explored in our day, so a vast reservoir of nitrogen, the main desideratum for the worn-out corn-fields of Europe, cannot long be left within a few miles of the sea, passed almost in sight by our steamers, yet still nearly inaccessible at the foot of the Andes.

Pusey, December, 1852.

From Mr. Keary to Mr. Pusey.

Dear Sir,—In reply to your questions: salt has been used in combination with nitrate of soda about ten years in West Norfolk, amongst a few farmers only; but during the last three or four years the use of nitrate alone, and mixed with salt, has much increased. The addition of common salt to nitrate of soda, as a top-dressing for wheat in spring, was first introduced by Mr. Henry Blyth, of Sussex Farm, near Burnham-Market, in this county.

2nd. In 1850 we had some very dry weather in the spring, immediately after the application of the top-dressing, which, I am inclined to think, was the cause of the comparatively small benefit arising from the application of the nitrate of soda.

3rd. I rarely thrash much wheat at this season of the year, and cannot, therefore, give a decided opinion as to the yield. I top-dressed very nearly 400 acres, at the rate of 6 and 7 stone per acre, combined with double the weight of salt, and I certainly never had apparently finer crops of wheat. The whole of the wheat crop in this district was blighted more or less; but I am quite sure that the *top-dressed* wheats were not more affected than others. I should say the average increase of corn per acre in this district, from the use of nitrate, at the rate of 6 to 8 stones per acre, and salt, is about 6 bushels per acre in average seasons. I have never yet met with any instance, where nitrate of soda was *properly* and *judiciously* applied, in which it did not pay a large percentage upon the outlay.

I remain, dear Sir, yours faithfully,

Holkham, Dec. 21, 1852. H. W. Keary.

From Mr. Garnett to Mr. Pusey.

Dear Sir,—I have used nitrate of soda as a top dressing for the last ten years, but in all cases, when used in the spring, unless used along with the soluble silicate of soda, I found that it produced a morbid action in the juices of the straw, which was always followed by mildew, and the same result was produced by guano; but applied with salt in October the result is very different —the over-luxuriance is dissipated long before the wheat is ready to shoot, and the result highly beneficial.

My present system of growing wheat year after year on the same land is to plough in night-soil and coal-ashes; and when the wheat is well up, sow nitrate and salt, 2 cwts. of each per acre. By this plan I had a crop of 40 bushels to the acre in 1850; 50 in 1851, and in 1852 a little more than 60 bushels per acre. I had another field of wheat in 1852, which had been potatoes in 1851. Here the wheat was sowed without manure, but received the salt and nitrate, 2 cwts. each per acre, and in this instance my crop was 63 bushels per acre. My remarks as to spring-dressing are only meant to apply to Lancashire. For instance, in the dry south-eastern counties it seems a common practice to apply farmyard manure directly to the wheat crop, but I never so applied dung to my own land without injury both to the straw and grain.

I am, Sir, yours faithfully,

Thomas Garnett.

Clitheroe, Jan. 12, 1853.

XVII.—*On the Improvement to be made in Land by amending the Channels of Rivers and other Watercourses.* By W. Bryan Wood, Land-Surveyor, Barnbridge, Chippenham.

To Mr. Pusey.

Dear Sir,—The drainage of wet lands being justly regarded as the most effectual and permanent improvement that can be made in them, and their underdrainage having of late years been so extensively carried out by the aid of Government and by private enterprise, it appears not untimely now to call attention to the great extent of wet land adjacent to rivers and brooks, which cannot be drained for want of sufficient outfall, to the great injury done to such land by the overflowing of their waters, and to the frequent heavy losses the occupiers of them sustain from floods, by sweeping off and damaging their crops, of which this year has furnished too many proofs; and to remedy which there exists in most instances no difficulty in the fall of the land through which the water passes.

Every year makes it more necessary that the natural watercourses of this country should be amended, as it is likely that the injury resulting from their present state will increase; indeed it is already remarked that it has increased—the under-drainage

of the land and deepening the ditches on many estates occasioning the flow after rains of a body of water at once into the rivers, which in former times either reached them by slow degrees or remained stagnant in the land till evaporated by the summer's heat: the consequence of such an addition of water must be, that in some localities sudden and high floods will become of more frequent occurrence.

The present state of brooks and rivers in tolerably level districts is that for which my aim is to gain chief consideration, the lands there being more or less subject to be flooded, or so little above the water in its course that they cannot be effectually drained; and there are many of these lands that would, if properly drained, rank among the best. Considerable disappointment has resulted from under-draining some lands thus situated. I have occasionally heard complaints of the lands being less productive after draining; this I believe has been the case where land, before it was drained, produced heavy crops of coarse grass; the drains being placed only deep enough to dry the surface, the subsoil still remaining full of water, the grass has diminished in quantity without any counterbalancing improvement in quality.

The produce of lands bordering brooks and rivers, where the surface of the land is at all times so little above the lowest level of the water that the subsoil immediately under it is never freed from stagnant water, is usually rushes or grasses of the most inferior description; and even lands that are only occasionally flooded, and which are at other times sufficiently above the water to get enough drainage to allow the growth of large crops of grass in favourable seasons, are liable to have the crops of hay spoiled or washed away and the feed rendered of little value by summer floods.

Floods in winter on the last-described lands may increase the produce when the water remains on the surface but a short time; but when the water is often out, or remains lying over it for days together, or late in the spring, it does decided injury to the crops: the produce, too, of land subject to floods is much inferior in feeding quality to that grown on land not flooded.

In smaller brooks the floods and retention of water in the land are occasioned by the tortuous and shallow channels often full to the brink with their ordinary supply, and also not uncommonly covered at the sides with trees and bushes of all descriptions stretching across the stream, and so impeding the water that when an addition is made by rain there is no escape but by overflowing the land.

In larger brooks and rivers the obstructions are the abrupt turns and windings of the course, shallows, islands, trees and bushes growing into the stream; bridges which appear to have been built

only with regard to the passage over, having low and narrow arches and uselessly large piers; and lastly, though not the least cause of damage on many streams, are the mills. In many instances a mill affects the drainage of much land, sometimes hundreds of acres above it, and does yearly more damage to such lands by pounding the water than its annual rent bears any comparison to.

I believe there can be found, with few exceptions, a sufficient fall in the course of all rivers and brooks to carry off superfluous water, and to drain or give good outfall for the under-drainage of the adjoining lands.

In order to obtain the advantage of that outfall, the water of the small brooks should not be carried off by watercourses of a less depth than 4 feet, having a regular incline at the bottom, and in as straight a line as the nature of the course will admit of, the curves being of a radius large enough to allow the water to run easily round them. The size and depth of the watercourse must of course depend on the quantity of water it is required to carry off, and the nature of the land it has to pass through.

To carry off the water from larger streams all the obstructions in their bed and sides require to be removed, the turns straightened, the channels made of as regular a width and depth as practicable, and the bridges, where not large enough, altered, or arches added to them.

Ample outfall might be obtained on some rivers by abolishing some of the mills or other impediments of like nature, and scouring out and deepening their present channels, and on other streams that are very winding by merely straightening their course, which in streams from about 15 to 25 feet wide would be of comparatively small expense.

By obtaining the best fall for the water of the rivers an opportunity would be opened for irrigating the land now damaged by their overflow, particularly where a mill could be done away with: and now the application of steam power is so general, there remains no necessity for keeping up many of the watermills, which are not unusually situated too far from market to be able to enter into trade against the competition of mills close to markets or railway stations, and inconveniently and too thickly placed as regards grinding the corn of the district; the water required for a mill, setting aside the damage it might do by its present use, would often, if applied to the irrigation of the land, make a much greater return.

The improvements I have suggested may be effected to a considerable extent on large or compact estates, and in small streams much improvement, even in short distances, might frequently be made at a trifling expense; but there exist at present too many legal difficulties in the way of accomplishing them where rivers

or brooks pass through many small and intermixed properties, for it would hardly be possible, where many parties were interested, to get all to agree to an efficient plan of improvement, or to the exchanges of land required to perfect alterations in the course of a stream.

To improve thoroughly the drainage of some districts, the whole length of the watercourses through, and far enough beyond them, to gain a good outfall, should be subjected to a well-ordered system of drainage, which should embrace, where practicable, the construction of carriers for irrigation; and to insure that the improvement should be made on the best principles, it would be well that no work of such magnitude should be proceeded with until the plan of it was approved by an inspector appointed by Government.

The expense of these improvements might be charged on the land benefited by them; and I am convinced there would be an excellent return for the outlay. An amount equal to the value of the loss occasioned by the floods of this year on some streams would I doubt not pay a great part of the expense of rendering them not liable to overflow; and in cases where the land could be converted to water-meadow, its value may be more than doubled at a comparatively insignificant outlay.

To exemplify to some extent the injury resulting from the present state of the rivers, I would draw attention to the state of the great outlets for the water of our district—the Thames* in Gloucestershire, Berkshire, and Oxfordshire; and the Avon in Wiltshire. Those who know the Thames in the neighbourhood of Oxford, especially between Oxford and Lechlade, will recollect to have often seen the country along the whole of its course between those places inundated for a great width, the water covering the land upwards of a mile wide where it meets some of the many small streams that discharge themselves into it.

The Avon between Malmesbury and Bath overflows after heavy rains, covering the lands adjoining to the extent of from 50 to 200 acres in a mile.

The loss and deterioration of the land occasioned by the floods and want of outfall on these rivers is enormous, as most of the land might be made of the very first-rate quality. Now all of it is injured, some almost valueless. There is no opportunity of

* As a sufferer in common with many neighbours by the increasing floods of the Thames, I cannot but think that the whole subject of navigable rivers throughout England deserves re-consideration, now that their utility for the transport of goods is very much superseded by railways; while on the other hand the more rapid conveyance into them of water by drainage renders them more than ever injurious to the health of towns, and obstructive to agricultural improvement. There are fields in this neighbourhood which have been covered for months; and in a former year a large meadow of my own was not seen from the end of July until the following March.—Ph. Pusey.

improvement by underdrainage, and frequently the whole produce of the year is swept away or spoiled by a summer's flood.

That sufficient outfall may be obtained in the Thames, the weirs, locks, and other impediments testify. With the Avon I need only remark on the great elevation of the country it runs through above Bath as compared with that city, as it needs only ordinary observation of that fact to convince that there is ample fall for the water.

In support of my observations on smaller streams, I will give a few instances of the comparatively trifling cost of amending the course of small streams selected from some of the works I have had executed under the powers of the Enclosure Act of the 8th and 9th Victoria.

At Milton-under-Wychwood, Oxfordshire, a watercourse of about a mile in length, made at a cost of about 50*l*., passing through land which was always more or less wet, and occasionally flooded for an average width of 4 chains, together with some cottages and gardens lying near its course, has carried off all the water in the most rainy seasons, and altogether improved the land mentioned; the increased annual value of which, and the cottages, in consequence of the new watercourse, is not less than 500*l*.

In the same place, another watercourse of about half a mile long, and from 4 to 5 feet deep, was made at a cost of 25*l*. through land that for the most part was boggy for an average width of 3 chains; one field at the lower end being so much so, that it was difficult to pick one's way about it without sinking ankle deep; all of which became perfectly drained after cutting through it, some of the wettest being now ploughed to the edge of the new watercourse. It also provided an outfall for draining about 4 acres of boggy land near, then scarcely of any value, and an outlet for the drainage of the adjoining lands. I estimate the increased value of the land cut through and the bog at 380*l*.

In stating the value of the improvement made by these watercourses, I have only taken into account the property immediately and wholly affected by them; in addition, they afforded good outlet for the drainage of other land, and partially drained some of it. The advantages thus derived from the watercourses would alone be of more value than the cost.

In an adjoining enclosure a brook newly cut, 20 feet wide and 7 feet deep, the length of 54 chains, and improved for 12 chains, and a smaller brook cut straight, 5 feet deep, for about 30 chains, at a cost together of 158*l*., improved the meadows in the hamlet not less than 500*l*., and the meadows on the other side of the larger brook, and higher up the stream, to the same amount at the least: the owner of part of them paid 42*l*. 10*s*. of the expense. In this case the damage to the crops

by the floods of this year *would alone have been equal to the amount expended if the course had been unaltered.*

In another enclosure, a small mill having a fall of 8 feet kept the water back on about 300 acres of land immediately above it, about 50 acres of which were nearly of the same level with the water from the mill-pound when penned to its height, and the remainder, as well as the village, a mile off by the course of the stream, from one to three feet only above the water in the stream in ordinary times; the village was only five feet above the level of the water at the mill-head, and the ditches throughout the village full of water. There were also 160 acres of land, the nearest part of which was 7 feet above, and $1\frac{1}{2}$ mile and 4 chains distant from the mill-head, and the farthest part $2\frac{1}{4}$ miles and 10 chains distant from, and 9 feet above, the mill-head, and from 400 to 500 acres of land adjoining and farther up the water, continually in a wet state, which could not be remedied by drainage, for want of an outfall.

The removal of the mill would have given an 8 feet outfall for all these lands, and increased their value at once 7000*l.*, at a cost of about 2000*l.* for compensation to the mill-owner and amending and lowering the watercourses, and have sunk the water 8 feet below the village, and thus improved its health and comfort, which I have not included in the estimated increase of value. The removal of the mill would also have given an opportunity of irrigating from 200 to 300 acres of land, and afforded sufficient outfall for the complete underdrainage of upwards of 800 acres of land, the drainage of which the lowering the watercourses throughout would not have perfectly effected. The value of these additional means of improvement would not have been less than 6000*l.* or 7000*l.* in addition; it might very possibly have been much more.

There being then no provision under the Enclosure Acts for taking the mill for the purposes of the enclosure, that plan of improving the drainage was obliged to be abandoned, and I had a nearly straight watercourse made from the mill-pound, keeping the bottom almost level up to the 160 acres before mentioned through which I carried two watercourses 6 feet deep to the upper end, which have kept it tolerably dry in the wettest seasons since, although the drainage is not perfect: this watercourse lowered the water at the village about 3 feet, and considerably improved the other land it passed through. It cost 655*l.*, including bridges over the roads where there were none previously, and a weir near the mill for the water to fall over when it attained the height of the mill-head, and increased the value of the property it affected, not taking in the village, about 2000*l.*

I had another watercourse carried up from below the mill, and

by a culvert under part of the mill-stream into, and partly through, at a depth of 7 feet, about 140 acres of land that was but a little above the level of the mill-head. The bottom of this drain was gravel and sand, and it perfectly drained 100 acres of the land, and benefited the other 40 acres and the adjoining lands: it cost 205*l.*, and increased the value of the land 1500*l.*

Although in these remarks, which I do not intend to apply to tidal rivers, I have treated the land that may be improved as meadow, there is much arable land similarly circumstanced, and consequently subject to much greater injury; and some of the grass-land that, if drained, might with profit be converted into arable.

In addition to raising the value of the land, the advantages of these improvements would be great to the country in affording employment, in the health of the inhabitants, and in the increased production of the soil.

XVIII.—*Report on Inoculation for Pleuro-Pneumonia in Cattle.* By Professor Simonds, of the Royal Veterinary College.

In presenting a report on the subject of the prevention of Pleuro-pneumonia by inoculation, it may be observed that there are few things, connected with the diseases of domesticated animals, which have of late years more painfully interested the agriculturist, than the existence of this malady among cattle. The affection has spread far and wide in this country, and destroyed great numbers of our cattle, under circumstances of the most opposite description, in consequence of its possessing all the characters that belong to an epizoötic disease:—thus not only the hopes of the farmer have been blighted, but in many instances his ruin has been nearly effected. As we know but little of the causes which have produced its repeated outbreak in certain localities, as well as its continued existence in others, so we are equally ignorant of those which led to its first introduction into this kingdom. Unlike many similar disorders, it cannot be traced to the direct importation of animals in whose system the disease was incubated, but like cholera and other epidemics, it seems to have visited our shores, through, as has been supposed, a peculiar contaminated state of the atmosphere.

Perhaps the only point which has been clearly established with reference to its appearance here, is its prior existence in Germany and other parts of the Continent; where for some years it had proved very destructive, and where it still remains unabated in severity. Various as have been the attempts at prevention as well as cure, all at times have proved alike ineffective, and it

may truly be said that none of these means have stood the test of extended experience. Under these circumstances it was to be expected that the Royal Agricultural Society would endeavour, by every means at its disposal, to throw some light both upon the nature of the malady and the laws which governed its spread, and likewise upon the causes which, although secondary in their operation, were supposed to exert an important influence on animals in favouring the attack. This it has done by the awarding of prizes of great pecuniary value for the best essays on the subject; by the publication of papers in the pages of its Journal; and by the delivery of lectures before its members at their annual meetings. Great benefit no doubt has accrued from these several means, but still the pest remains among us, and at times seems uncontrolled in its virulence. The last supposed beneficial method of combating the disease which has engaged the attention of the Council is that of inoculation, a prophylactic to which their attention was originally directed by the Continental publications. It was not, however, deemed advisable at once to take any steps upon these reports, except to request the Professors of the Veterinary College to watch the progress and results of the system, and to give them their opinion of its value. In June last a letter was received by the Council from His Royal Highness Prince Albert, enclosing a communication which had been forwarded to him on the subject.

From this communication, as well as from repeated notices in the Belgian papers particularly, and the statements of different members of the Society, it appeared that a safe, ready, and effective preventive was found in inoculation. Under these circumstances the Council lost no time in adopting means for a perfect investigation of the subject; and at their meeting in July I was directed to take such further steps as might appear best calculated to effect the purpose. Acting on these instructions, and with the concurrence of the Chairman of the Veterinary Committee, I was led to visit Belgium, the plan having had its origin there. At the Veterinary School of Brussels I found eight cows under experiment, they having been inoculated *fifteen* days prior to my visit with some serous fluid taken from *the lung of an animal which had died of pleuro-pneumonia.* The operation, which had been performed by Dr. Willems, was undertaken by the direction of the Government, who had sent the animals to the School that the effects of the inoculation might be daily watched by the Professors. The punctures made in their tails (the usual place of inoculation) presented a very healthy condition, and it was evident that a few more days would suffice to complete the healing process. The animals were feeding well; and, with one exception, a cow having a sloughing ulcer of about three

inches diameter on the ischium, they appeared to be in health. This ulcer was described to be an effect of the inoculation in the tail, the system of the animal being thereby impregnated with morbific matter, and which in numerous instances, I may here remark, produces far more serious results than were observed in this particular case. These animals, when reported to be in a fit state, were to be sent to various parts of the country and mingled with others labouring under the disease in its different stages. From Brussels I proceeded to Hasselt, and had an interview with Dr. Willems, by whom I was politely received, and who, during the whole time of my stay in Belgium, showed the greatest readiness to assist me in the investigation. The town, which is the capital of the province of Limbourgh, is situated on the confines of the great marshy district of Holland. The land around it is remarkably flat, and on one side only is under the plough, being on the other divided by ditches into meadow and pasture grounds. During the last sixteen years it is said never to have been free from pleuro-pneumonia, and in this time hundreds of animals have died within it. It is a place full of distilleries, and contains from 1400 to 1500 cattle in the summer, and upwards of 2000 in the winter; the animals being fed on the refuse grains, &c., and, when fat, sent to the markets. From the situation, want of drainage, and accumulation of the filth of the town itself, added to the system of feeding the cattle, the kinds of food, neglect of ventilation of the sheds and removal of the dung, &c., Hasselt may be considered as the very centre and focus of a disease like pleuro-pneumonia. The cattle also of the farmers in the neighbourhood are, in general, very poor and badly provided for, and the sheds they inhabit dirty in the extreme:—thus secondary causes, as predisponents to the disease, are in full operation, both within and without the town. The malady is believed to have had its origin from some peculiar contamination of the atmosphere, and to have extended from Germany to Holland and Belgium in 1828. Its introduction, however, into Hasselt in 1836 is ascribed by Dr. Willems to some diseased animals purchased by a cattle-dealer in Flanders, and which subsequently came into the possession of his father and also of M. Platel, distillers in the town. The common people have been taught to regard the visitation as a judgment of St. Brigita, the patron saint of the cow, according to the Romish Church. The image of this saint adorns one of the churches in Hasselt, and is bedecked with numerous votive offerings of wax and tallow models of strange-looking cows.

These circumstances and opinions prove that the occurrence of pleuro-pneumonia is as little understood in Belgium as in

this or any other country. The father of Dr. Willems, generally, keeps in his sheds about 80 cows and oxen in the summer, and from 100 to 120 during the winter, feeding upon the grains, &c., obtained from the distillery. The animals, as they become fat, are disposed of, and their places quickly filled up by new purchases. The stock, therefore, is very often changed, and since 1836 he estimates his losses at fully 10 per cent. in each year. The losses of other persons have been quite equal to this on the average, while in numerous cases they have been considerably more. It appears that about two years since (December, 1850), Dr. Willems, having failed to arrest the disease in his father's herd by either hygeinic or medical treatment, had recourse to inoculation, as an experiment upon one or two animals; but it was not until the following February that he adopted it to any extent. Between this date and the commencement of 1852 he inoculated 108 animals belonging to his father, not one of which, it is said, contracted pleuro-pneumonia, although all were exposed to its contagion. Fifty other animals, also the property of Willems sen., were left *un*inoculated during the same time, and of these, 17 took the disease, and were destroyed. These facts, with some others bearing on the same point, were embodied in a memoir, and presented to the Minister of the Interior by Dr. Willems in March last, and within a few weeks, from the publicity given to the subject, inoculation became pretty general in many parts of Belgium.

Up to the period of my visit *twelve hundred* animals had been inoculated in Hasselt, with but *ten* deaths; and I was informed that the disease was nearly exterminated for want of subjects to attack, immunity being given by the operation. This number gives but a faint idea of the extent of the practice, as more animals are daily being inoculated in different parts of the kingdom; and Dr. De Saive, I learn, has operated upon no less than 1500 in the provinces of Rhenish Prussia. It seems that, upon publicity being given to the subject, Dr. De Saive wrote to the Governments of France, Holland, and Prussia, offering to inoculate the cattle of these several countries upon some *improved* plan, of which he claimed to be the inventor. Not succeeding immediately in his object, he made arrangements with the local authorities in the different provinces of Rhenish Prussia to carry out the operation. The practice, however, was attended with such ill success, so many animals losing their tails from ulceration and mortification, and others being destroyed by constitutional irritation, that the Government, hearing of these disasters, ordered the inoculations to be forthwith discontinued. No doubt that very many of these untoward results were caused by the serous exudations selected for the inoculations being of bad quality, and by

the manner of performing the operation. It remains, however, to be proved that, even with the greatest care, the casualties may not be so numerous as to offer a serious drawback to the adoption of inoculation, if it should hereafter be satisfactorily shown to be a preventive of pleuro-pneumonia.

Deputations have been sent by France and Holland, and also by the Belgian Government, to Hasselt, to inquire into the value of the practice, but up to the time of my visit Prussia had not taken this step, nor had Dr. Willems been requested to undertake any inoculations in that country. This delay may possibly have arisen from the ill consequences of Dr. De Saive's operations producing a want of confidence on the part of the Government of Prussia. From a letter which I have recently received from Dr. Willems, it appears that experiments are being carried out both in France and Holland at their respective veterinary schools, and also that Prussia is about to follow the example of these countries.

The Government of Belgium is taking the liveliest interest in the matter, and has instituted a series of valuable experiments, so that ere long it will be satisfactorily proved whether inoculation is or is not a certain and safe preventive of the disease. It is a fact long since established in medicine that many contagious diseases can be readily communicated from animal to animal by inoculation, thereby giving immunity from an attack of the "natural" disease. The "inoculated" disease also, as a rule, proves of a less dangerous character than the natural, but it is especially to be remembered that *in their nature both are essentially the same.* The advocates, however, of the inoculation of cattle build the success and value of their practice on the very opposite basis, because they say in no case *is disease of the lungs* caused by the introduction of the morbific matter into the system. Were disease of the lungs to follow, it would be at once fatal to the practice, because its effects being made manifest within these organs could not be controlled, and would assuredly lead on to death. The local disease caused by the inoculation, we are told, is of the same nature as that in the lungs of affected cattle; but is said always to remain *localized*, because *artificially introduced* into the organism. About two per cent. of the inoculated animals die, while a far greater proportion suffer from ulcerative and gangrenous inflammation of their tails, notwithstanding which the lungs, *the locale of the natural disease*, we are assured, never suffer. If experience proves this to be true, it must be regarded as a new fact in medicine.

We believe each virus, no matter how introduced, naturally or artificially, into the system, to have its own especial seat in the organism. Thus the virus of glanders produces glanders, and

the same may be said of farcy, small-pox, cow-pox, rabies, and many others, all of which produce their like, and are figured forth in some especial organ of the body.

The inoculations of pleuro-pneumonia are made then, as we have seen, in the belief that this disease is highly contagious, and spreads itself from this cause, as well as the special causes of the extension of an epizoötic; and that the operation engenders a peculiar state of the system which, without imparting the disease *itself* to the animal, gives immunity against all the causes which produce it. With regard to attempts being made to control epizoötic diseases of various kinds, I may here remark that Dr. Layard, a celebrated physician, wrote an essay in 1757 strongly recommending the inoculation of cattle to prevent their falling a sacrifice to a destructive malady which at that time prevailed in this country. It does not, however, appear that beyond a few experiments the practice was carried out, although these inoculated animals were said to have been placed amidst the infection without sustaining injury.

I have before alluded to the interest shown by the Belgian Government in this matter, and I have now to observe that in the early part of this year two *diseased* cows were sent by order of the Minister of the Interior to Hasselt, to be placed with *six* inoculated animals, the property of M. Willems, sen. Eight days afterwards these two cows died, but the six inoculated animals had remained well down to the time of my visit. *Two* other cows were inoculated, and subsequently sent to the farm of M. De Moulin, near Hasselt, and placed with *thirteen* of his cows then ill. These two animals continued unaffected, while, of the thirteen, nine died, and four were restored by medical treatment. I went over to this farm and saw the cows belonging to the Government, and I ascertained that M. De Moulin had *seventeen* cows originally, *four* of which, although not then inoculated, *escaped the malady*. It is true, these four animals were subsequently inoculated, and when I was there no disease had existed for three weeks; but still their escape, at the time the thirteen cows fell ill, militates against inoculation being the sole protection of the Government cows. On inspecting the cattle of the different distillers I found several who had objected to have the operation performed, and *their animals had during the summer been as free from disease as the others.*

All parties agree that they have most disease in the winter, when the town is fullest, and when the secondary causes I have named are in active and vigorous operation. It is also admitted that in some summers since 1836 they have had as little disease as during the past. Similar things have occurred in the experience of most persons, and are not without their value in an investiga-

tion of this description. It would appear that the malady was likely this year also to increase towards the autumn, as three or four cases occurred just as I was about to leave Hasselt; and it is therefore probable that inoculation may have a severe test even in that place. These cases happened to *non*-inoculated animals, and in sheds where some had been inoculated. Thus M. Vanstraelen keeps twenty-four, of which eight only were inoculated; a *non*-inoculated cow was taken ill on September 2nd and died on the 10th, being allowed to remain with all the others three or four days before removal. M. Rousseau keeps twenty-seven, and has not had any inoculated, notwithstanding which his cattle were exempt from the disease for *seven months*, and up to the last week in August, when one was taken ill and sold; another was attacked within a few days, and was evidently fast sinking when I saw her. These animals also had free communication with the others. Such instances as these are sufficient to establish the points just referred to; and it becomes therefore unnecessary to multiply cases of the same description.

The statements given by different persons are very contradictory, as will appear from the sequel of this report. Even on the subject of protection by inoculation Dr. Willems does not allow a *single failure*, while others assert that several such cases have occurred. With regard to the local indications of a successful inoculation, although I witnessed many operations performed by Dr. Willems, and inspected the parts at different intervals afterwards, I saw none which, to me, were satisfactory. Unhealthy inflammation, ulceration, sloughing, and gangrene, were far too frequently the results of the operation. The punctures are made very deep, with a double-edged scalpel, which is thrust through the skin, and moved from side to side to allow the two or three drops of fluid used for the inoculation to penetrate to the bottom of the wound. Surgical and scientific principles certainly did not rule in these operations. What the effects may be of a different mode of procedure I am unable to say, but to establish the value of inoculation further experiments should be adopted. Another point of the first consequence is susceptibility to a *re*-inoculation. It is said, by the advocates of the system, that susceptibility is entirely destroyed by the first inoculation: and among other animals which I was shown by Dr. Willems were two cows belonging to his father that had been operated upon fifteen months, and which, he assured me, he had *re*-inoculated three or four times, and in each instance without success. Capability of transmitting "the virus" from animal to animal, by what is technically called removes from the original source of the inoculating material, is also another very important question. The lymph of the vaccine

disease, small-pox, &c., is made milder and safer for use by these removes; and supposing the truth of the system of inoculating cattle, as a preventive of pleuro-pneumonia, to be established, it is of the first importance that a *safe* as well as an *efficacious* material should be employed. These points will undoubtedly receive elucidation by the experiments now being adopted at the several Continental schools of veterinary medicine. It is a question, however, well worthy the attention of the Council of this Society, as to whether any efforts should be made here towards an obtainment of information on such important subjects. We are told that these problems are solved, and that experience has confirmed the truth of the conclusions; but, at the least, I can affirm from my own observations that the practice of the inoculators does not bear out their assertions, nor is it conducted as though these things were known.

Dr. Willems says he has carried "the virus" through five removes, and that no deaths and fewer casualties arise from the operations made with the product of such inoculations, and yet, strange as it may appear, he unhesitatingly asserts that he prefers the original exudations from the diseased lung. Nay, of this I had plenty of proof, as upwards of thirty newly-purchased animals were allowed to remain *un*-inoculated for upwards of a week, until he could obtain some fluid directly from the affected lungs of an animal destroyed by the malady. Another instance of the same kind was afforded me two days before leaving Belgium, when I accompanied M. Willems from Hasselt to the veterinary school of Brussels, where eight cows sent by the Government, in addition to those before mentioned, were waiting his operations. On the morning of our arrival a cow had died of pleuro-pneumonia, from which he inoculated these animals, and *re*-inoculated two of those I had seen at my first visit. M. Willems promised to send me the result of these experiments, and has done so in as far as the eight cows are concerned. With reference to the period of incubation of "the virus," it is said to vary from ten days to a month, but I am of opinion that no correct data can be obtained on such a subject from the rough and unscientific operations I witnessed. It is, perhaps, right I should here state that the Professors of the Brussels School are only the observers of the practice, the Minister wishing M. Willems to act independently, and to report when the animals are in a condition to be subjected to counter-proofs, such as cohabitation with diseased animals, *re*-inoculations, &c. &c. by the Professors. I have spoken of the tail as the part selected for the introduction of the virus; it is necessary to add that the extremity of the organ is chosen, so that amputation may be resorted to in those cases where mortification super-

venes upon the inoculation—thus affording the animal a chance of recovery at the expense of this member of its body. It is, however, by no means unfrequent that amputation fails to arrest the progress of mortification, of which one notable exception was seen by me among the animals belonging to M. Willems' father. The quantity of serous exudation employed never exceeds two or three drops, and it certainly is not a little remarkable that such serious consequences should so often follow its introduction into the system. The material is evidently morbific in the extreme, and probably is either dead or possesses so small an amount of vitality when used that it soon dies, and as such gives rise to chemical action, ending in the speedy destruction of the tissues, more particularly in so lowly an organized part as the tail. In very many cases, even when ulceration or mortification does not occur, the inflammatory action runs so high and the tail enlarges so much, that deep incisions, some three or four inches long, have to be made to give relief to the engorged tissues. These untoward results do not probably occur in more than twelve or fifteen cases in every hundred, but they show how important it is to adopt means to procure a milder and safer material for inoculation than that obtained directly from the lungs. Cases of this kind invariably produce great constitutional disturbance and consequent emaciation, and call for long-continued medical treatment. At the commencement of these experiments some persons inoculated in the dewlap, and the effects were far more destructive than those I have described. In one instance in particular, *the exudations of a gangrenous lung being employed on eighteen animals, twelve out of the number died.*

Much stress has been laid on the microscopic appearances of the exudations obtained from the inoculated parts, in order to show that peculiar corpuscules possessing a tremulous motion are therein developed, and that these, most probably, are the true agents of the communication of the special disease. The instrument used at Hasselt by Dr. Willems and myself was very inferior, and no dependence could be placed in its defining powers; and from what I have since observed I believe that none but ordinary inflammatory products exist, and consequently that no special corpuscules will be met with in these exudations.

In bringing this Report to a conclusion I am desirous of adding the statements of two or three persons with whom I had interviews, in order to prove how much has yet to be learned respecting the value of inoculation, and the necessity also which exists for the adoption of independent experiments. M. Maris, veterinary surgeon of Hasselt, and one of the commission appointed by the Government, says that he wants more experience in the operation, as he is not satisfied with his

own or Dr. Willems' inoculations. He has operated on upwards of a thousand animals since the 15th of April, with seventeen deaths; and has furnished the Government with the full details of these cases. Since April he has attended about fifteen or sixteen animals affected with pleuro-pneumonia in the town. Hasselt, during the summer, is in general pretty free from the disease, and fresh cattle entering it at this period of the year are not so susceptible of the malady as those located there. In November the disease usually begins, and becomes more rife through the winter. Some of the distillers have not inoculated, nor have they had the disease: others commenced the plan, but discontinued it from the casualties attending the process. A great many animals have lost their tails. He frequently inoculates in the dewlap, but is most careful in selecting "the virus." Of *fifty* animals successfully inoculated at first, *twenty-five* took by a *re*-inoculation. A cow, successfully *re*-inoculated at St. Trond, had the *natural disease* ten days afterwards, but recovered from the treatment had recourse to. At St. Trond, also, three cows died from pleuro-pneumonia, which had been satisfactorily inoculated; the first was attacked twenty days afterwards, the second two months, and the third three months and a half. These animals were under the care of M. Wainots, veterinary surgeon.

Another veterinary surgeon of Hasselt, M. Vaes, says that since April he has inoculated four hundred animals with complete success—that all have been exposed to the contagion with impunity. Tried *re*-inoculation on twenty, and only one was affected a second time. The *re*-inoculation was done four months after the first. About 2 per cent. die from the inoculation. Of one hundred and thirty beasts ten only lost their tails. Believes fully in the advantages of inoculation, and that no other preventive but this is of any use.

M. Douterluigne, veterinary surgeon of Brussels, also a member of the Government commission, says that his own inoculations too often prove destructive of the organism of the tail, which inflames and passes on to a gangrenous condition. That he is perfectly satisfied that very many animals will take by a *second* after a *first*, *successful*, inoculation. Has seen many deaths from pleuro-pneumonia subsequent to inoculation. Considers M. Willems far too confident in the value of the operation; and adds, that when these successful *re*-inoculations and occurrences of the disease after inoculation have been named to him, he has always answered, "All such results depend entirely on improper original inoculations, for when these are properly done the operation is a perfect and complete prophylactic." M. Douterluigne also informed me that he had frequently

visited Hasselt, and made inquiries independent of Dr. Willems, and found there were many objectors to the practice, and also doubters of its efficacy. I learned also from him that in the neighbourhood of Brussels very few cattle had been inoculated, and that several veterinary surgeons in different parts of the country, from observing the ill effects, had declined to go on with the practice.

As an *addendum* to this report I trust I may be permitted to direct the attention of the Royal Agricultural Society of England to a series of questions attached hereto, which have been prepared on the subject of pleuro-pneumonia by a committee of a Society established in the metropolis for investigating the cause and nature of epidemic diseases. As a member of that committee I can bear testimony to the value of these questions; and as the first object is to circulate them as extensively as possible among the cattle proprietors and others in this country, I trust this will be received as an apology for my intruding them on your notice. If we can but obtain a sufficiency of answers from all parts of the country to most of these questions, I have no doubt that we shall be enabled to publish such a report as must prove of the greatest value to the whole community, and to the agriculturist in particular.

1. Has the disease termed pleuro-pneumonia existed either among your own cattle, or among any which are under your immediate observation?

2. Has it prevailed in your neighbourhood, and if so, how near your own premises?

3. Did the disease *first* appear among the "old stock" of the farm, or among the animals which had been recently purchased?

4. Has it attacked any other variety of animals besides oxen?

5. What is the usual health of the animals kept on the farm, their average age and condition?

6. Were the breeding or the fatting stock first affected?

7. Can its appearance in your locality be traced to any special or direct cause, such as the introduction of diseased animals?

8. To what do you attribute its outbreak in your own herd?

9. Have the cows, either in calf or in milk, been more susceptible to the disease than the oxen?

10. Have you any proofs of calves being affected at birth or *very* shortly afterwards?

11. What was the state of the weather at the time of the outbreak, and were the animals, when attacked, exposed to, or protected from its influence?

12. Is it your opinion that the malady is contagious, and if so, what proofs have you?

13. How long a time has usually elapsed between exposure to infection and the appearance of the disease?

14. Were the losses quickly replaced by new purchases?

15. Did such newly purchased animals have free communication or not with those that had been previously living with the diseased, and if so, for what period of time?

16. Have these animals been the *subjects* of the disease?

17. Is the malady on the increase or otherwise?

18. What are the symptoms, marking the commencement of the attack, and are they easily recognised or not?

19. What are the symptoms that accompany the progress of the disease, particularly those that indicate the greatest danger?

20. Have any animals recovered in whom diarrhœa has shown itself in an advanced stage of the malady?

21. What number of cattle are kept by you? and how many have been attacked by the disease?

22. What number of these have died? and what proportion has been killed or otherwise disposed of?

23. What were the usual post-mortem appearances?

24. Was effusion into the chest usually present?

25. In how many cases were both lungs diseased? In how many was the right lung alone affected? And in how many the left alone?

26. In what state or condition has the disease left those animals that have recovered from mild or severe attacks?

27. Has it seemed to have any effect in producing abortion?

28. Do you know of any instances in which an animal has become a second time attacked with a mitigated form, or otherwise, of the disease?

29. State the causes which you have found to be the chief obstacles to the eradication of the malady.

30. How long is it since the first case occurred in your herd? and how long since the last case?

31. Has the disease steadily progressed, or have there been repeated outbreaks after intervals of freedom from disease?

32. Has prevention been attempted by change of diet, situation, or management, by medical treatment, or any other means?

33. What results have followed the adoption of the preventives employed?

34. Is the general character of the district in which you reside flat or hilly, dry or damp, wooded or open?

35. Are the pasture-grounds free from stagnant waters and bogs, and is land drainage generally adopted?

36. Is irrigation of the pasture-grounds carried out to any extent?

37. Are the cattle-sheds well drained and ventilated?

38. Is the system of "box-feeding" adopted, either upon accumulating manure, or upon boarded floors placed over pits for the reception of the dung and urine?

39. Did any blight, mildew, or similar affection manifest itself among your corn or other crops, previous to or about the time that your cattle became diseased?

40. Have any epidemic diseases prevailed among the people in your locality, either shortly before or during the appearance of the disease?

41. Does any other epizoötic affection, besides the one which forms the special subject of this inquiry, exist among domesticated animals in your district? If so, state, 1st, What animals are affected? 2nd, The leading characters of the disease? and 3rd, The per-centage of deaths it produces?

This List is returned by

Mr. ______________________ *(Christian and Surname.)*

Of ______________________ *(Parish.)*

Near ______________________ *(Post Town.)*

[Since this report has been sent in, arrangements have been made by Prof. Simonds, with the assistance of Mr. E. Denison, M.P., and through the liberality of Mr. Paget, of Ruddington Grange, near Nottingham, for thoroughly testing the efficacy of inoculation by well-considered experiments, an account of which will be given in a future number.—PH. P.]

XIX.—*On the Composition of the Parsnip and White Belgian Carrot.* By Dr. AUGUSTUS VOELCKER, Professor of Chemistry in the Royal Agricultural College, Cirencester.

THE parsnip has been analysed by Crome and the carrot by Hermbstädt. Both analyses, however, having been made at a time when the analytical processes with which chemists were acquainted were little calculated for giving accurate results, are necessarily very imperfect. They do not convey, therefore, a correct idea of the true composition of these roots.

The cultivation of both, especially that of the carrot, is gaining ground from year to year. It appeared to me, therefore, desirable to replace the former imperfect analyses by others,

in which advantage has been taken of the more refined and accurate methods of investigation with which modern chemistry has made us acquainted.

The parsnips and carrots analysed were grown on the farm attached to the Royal Agricultural College, in the calcareous, rather stony, and by no means deep soil.

Carrots, as well as parsnips, succeed best in a deep, well-pulverized, loamy ground, but in a shallow, stony soil they scarcely reach half the size as when grown on a deep and sufficiently porous loam.

The soil in the neighbourhood of Cirencester on the whole is not favourable to the growth of these roots, it being, in most instances, too stony and too shallow. The roots for this reason remain comparatively small, and 18 tons per acre are deemed a good average crop of carrots in this part of the country.

Before stating the results of the analysis of parsnips and carrots, I shall briefly describe the method which I followed in determining the various constituents entering into the composition of both roots.

1. *Determination of Water and Ash.*—The quantities of water and ash in the parsnip and carrot were determined by drying a weighed portion of the roots, at first in the air, subsequently at a gradually increased temperature, and finally in the water-bath at 212° F.

The loss in weight by calculation gave the percentage of water. The dried substance was then burned in a platinum capsule over a gas-lamp at a very moderate temperature. On account of the large proportion of alkaline salts in carrots and parsnips their ashes fuse readily. It is necessary, therefore, to apply in the preparation of these ashes but a moderate temperature, because too intense a heat has the effect of fusing them. The fusing salts surround particles of carbonaceous matter, and prevent their complete dissipation by fire by keeping out the atmospheric oxygen.

In order to obtain a fair average sample for the water and ash determinations, a whole root was cut into thin slices, from which a portion was taken for analysis after having been well mixed together.

2. *Determination of Cellular Fibre, insoluble Protein Compounds, and insoluble Inorganic Salts, attached to the Cellular Fibre.*—By a longitudinal cut a root was divided into two halves. One half was reduced into a homogeneous pulp by grating it on a fine grater. Of this pulp 1000 grains were digested with some cold distilled water, and the liquid, containing in solution gum, sugar, soluble casein, and other soluble matters, after some time was

strained through a piece of fine linen. The impure cellular fibre remaining on the linen was washed with cold distilled water until a drop of the washings ceased to leave a perceptible stain, and evaporated on a piece of platinum foil. When washed clean the impure fibre was dried in the water-bath, and its weight ascertained.

A portion of the dried impure cellular fibre was burned subsequently in a platinum capsule, and by this means the proportion of insoluble inorganic matters attached to the fibre was ascertained.

Another weighed portion of the finely-powdered and dried impure fibre was burned in a combustion tube with soda-lime, and the proportion of insoluble protein compounds contained in parsnips and carrots, and obtained in the analysis with the impure cellular fibre, was determined by calculation from the percentage of nitrogen furnished by the combustion of the impure fibre with soda-lime.

By deducting the amount of insoluble protein compounds and inorganic matters thus obtained from the amount of impure fibre the percentage of pure cellular fibre was ascertained.

3. *Determination of Starch.*—The milky liquid which, in the case of parsnips, passed through the linen was mixed with the washings of the fibre, and allowed to settle in a glass beaker for 24 hours. After that time the starch, which rendered the water milky, was completely deposited at the bottom of the beaker. The supernatant clear liquid was carefully passed through a previously dried and weighed filter, into which the starch was also transferred from the beaker. Being well washed with distilled water, it was first dried between blotting-paper, and finally in the water-bath at 212° F., and then weighed. Carrots, at least those examined, do not contain any starch, and the watery solution passing through the linen can therefore be heated at once for the determination of casein.

4. *Determination of Casein.*—The liquids from which the starch was separated by the process just mentioned were heated to the boiling point in a glass-beaker.

Not the slightest precipitate was produced on boiling, thus proving the total absence of soluble albumen, both in the carrot and in the parsnip.

A few drops of acetic acid were then added to the boiling liquid, when a copious flaky precipitate of casein was formed. This precipitate of casein was allowed to settle for 24 hours. After that time the clear liquid above it was passed through a weighed filter, on which the casein was also collected. The precipitate was washed with distilled water as long as anything

was dissolved, and then dried at 212° until it ceased to lose in weight.

5. *Determination of Gum, Pectin, and Salts insoluble in Alcohol.*—The solution separated from the casein was evaporated on the water-bath to a thickish syrup, which was treated with strong alcohol to throw down pectin and gum. The gum, pectin, and salts insoluble in alcohol thus precipitated were boiled repeatedly with alcohol in order to remove any traces of adhering sugar. When washed quite clean with alcohol, the residue was transferred into a weighed porcelain crucible, dried at 212° F., and weighed. On burning, gum and pectin were dissipated, and the salts insoluble in alcohol were left behind, which, being deducted from the weight of the impure gum and pectin, gave the proportion of pure gum and pectin.

6. *Determination of Sugar.*—The alcoholic liquids obtained in determining the gum and pectin were introduced into a retort, and the alcohol distilled off in the water-bath. The residue in the retort was transferred into a porcelain crucible, and, after perfect evaporation on the water-bath, dried at 230° F., until it ceased to lose in weight. The drying process of the sugar is exceedingly tedious, as it takes a long time to expel the water completely from the sugar.

The sugar thus obtained contains a considerable proportion of inorganic salts, soluble in alcohol. The weight of the latter was determined by exposing the impure sugar to a strong heat, at which the organic part was destroyed, and the inorganic matters were left behind in the form of a white ash. The weight of the ash deducted from that of the impure sugar gave the proportion of pure sugar.

7. *Determination of Fatty Matters.*—In order to ascertain the proportion of oil or fatty matters contained in carrots and parsnips 100 grains of the dried roots were repeatedly digested with ether, which readily dissolves all fatty matters. The ethereal solutions were passed through a filter, upon which the powdered substance, now exhausted with ether, was washed with this solvent in order to remove all traces of adhering fat. By distillation in a retort the greater part of the ether of the ethereal extracts was obtained back again. The residue in the retort, evaporated to dryness, was found to contain some sugar, which had been dissolved with the oil by the alcohol usually contained in ether. The oil was separated from this sugar by digestion with a small quantity of anhydrous ether, free from alcohol. On evaporation of the ether the oil was left behind quite pure, and its weight determined. It is essential to examine carefully the residue which is left on evaporation of the first ethereal liquids, for

commercial ether always contains some water and alcohol, which both dissolve a certain portion of sugar from the root. Unless care, therefore, is taken to extract the impure oil with ether perfectly free from alcohol and water, the oil contained in roots and other vegetable productions, furnishing sugar on analysis, will be estimated too high. Inattention to this point, perhaps, accounts for the great variations which are observable in the determinations made by different persons of the quantities of fat contained in the various articles of food.

8. *Determination of the whole Amount of Protein Compounds or Flesh-forming Constituents.*—As a check upon the direct determination of casein and the indirect determination of insoluble protein compounds, the whole amount of flesh-forming constituents in the carrot and parsnip was ascertained by the indirect method of combustion.

About 18 to 20 grains of the dried substance were burned with soda-lime. The amount of nitrogen obtained according to the method of Will and Varrentrapp, being multiplied by $6\frac{1}{4}$, gave the proportion of protein compounds in the roots.

9. *Determination of Ammoniacal Salts.*—Having found that the juices of many plants contained sometimes considerable quantities of ammoniacal salts, which necessarily must render the determination of the flesh-forming constituents in plants inaccurate, I was led, therefore, to examine these roots for ammoniacal salts, and have succeeded in detecting in them small quantities. The plan adopted for finding out the presence of ammoniacal salts in parsnips and carrots and of ascertaining their relative quantities was as follows:—

About 1500 grains of the finely grated roots were digested with distilled water, and washed upon a piece of fine linen as long as anything was extracted by water. The clear liquids were immediately precipitated with basic acetate of lead, a re-agent which separates completely all protein compounds. The bulky precipitate thus produced was carefully washed on a filter with distilled water, and the liquid, passed through the filter, after having been slightly acidulated with sulphuric acid, was evaporated in a porcelain dish to a small bulk. Thus concentrated, it was introduced into a retort, connected with a convenient apparatus containing some hydrochloric acid, and destined to absorb the ammonia which is given off during the subsequent distillation of the contents of the retort with soda-lime. It is necessary to choose the receiving apparatus sufficiently large to contain all the liquid in the retort, as the contents of the retort have to be distilled to dryness in order to obtain the last traces

of ammonia, which would remain dissolved in the water if no care were taken to evaporate the liquid completely to dryness. The ammonia, which is given off under these circumstances, is fixed by the hydrochloric acid in the receiving apparatus. Its quantity was easily ascertained by evaporating the liquid in the receiver to dryness on a water-bath, with the addition of bichloride of platinum. The precipitate of bichloride of platinum and ammonium thus produced was washed on a weighed filter with a mixture of alcohol and ether, in order to remove the excess of bichloride of platinum, which had been previously added. When quite clean, the filter with the insoluble double salt of chloride of platinum and ammonium was dried at 212° F., weighed, and the amount of ammonia which it contained calculated.

Having thus given a description of the mode in which the organic analyses were executed, we shall now proceed to state the results obtained in the analyses of both roots.

I. *Composition of Parsnips.*

Water.—1. Dried in the water-bath, the fresh roots lost 81·78 per cent. of water.

2. In another determination 82·32 per cent. were obtained; or, on an average, parsnips were found to contain 82·05 per cent. of water.

Ash.—1. 275·05 grains of fresh parsnip left, on burning, 2·60 grains of ash: 100 parts of the fresh root, therefore, contain ·941 per cent. of ash, or 5·16 per cent. in the dried state.

2. 275·7 grains of fresh parsnip left, on burning, 2·55 grains of ash: 100 parts of fresh parsnips consequently gave 0·924 per cent., or 100 parts in the dried state gave 5·23 per cent. of ash.

Protein Compounds.—1. 15·8 grains of substance, dried at 212°, burned with soda-lime, gave 2·88 grains of chloride of platinum and ammonium: or 100 parts of dry parsnips contain 1·14 per cent. of nitrogen, which is equal to 7·12 per cent. of protein compounds. In the natural state parsnips consequently contain 0·20 of nitrogen, or 1·25 per cent. of protein compounds.

2. 12·74 grains of substance, dried at 212°, burned with soda-lime, gave 2·42 grains of chloride of platinum and ammonium: or 100 parts of dry parsnips contain 1·19 per cent. of nitrogen, equal to 7·43 per cent. of protein compounds.

Fresh parsnips, according to this determination, therefore, contain 0·21 of nitrogen, or 1·31 per cent. of protein compounds. According to these determinations, the general composition of fresh parsnips may be represented as follows:—

	I. Experiment.	II. Experiment.	Average.
Water	81·780	82·320	82·050
Inorganic matters (ash)	0·941	0·924	0·932
Nitrogenised organic substances, capable of producing flesh	1·310	1·250	1·280
Substances free from nitrogen, and fitted for support of animal heat and the formation of fat	15·969	15·506	15·738
	100·000	100·000	100·000

And that of parsnips dried at 212° F.—

	I. Experiment.	II. Experiment.	Average.
Nitrogenised substances, capable of producing flesh	7·43	7·12	7·27
Substances not containing nitrogen fitted for support of animal heat and the formation of fat	87·41	87·65	87·54
Inorganic matters (ash)	5·16	5·23	5·19
	100·00	100·00	100·00

A glance at these numerical results will show that parsnips contain 6 to 8 per cent. less water than turnips, and 5 to 6 per cent. less than mangolds. The quantity of flesh-forming substances in fresh parsnips is about the same as that contained in turnips. In a dried state, however, turnips are richer in protein compounds than parsnips.

In the following table the results of the detailed proximate analyses of parsnips are contained:—

Detailed proximate Composition of Parsnips.

	In natural State.	Calculated dry.
Water	82·050	——
Cellular fibre	8·022	44·691
Ash united with the fibre	·208	1·159
Insoluble protein compounds	·550	3·064
Soluble casein	·665	3·704
Gum and pectin	·748	4·166
Salts insoluble in alcohol	·455	2·535
Sugar	2·882	16·055
Salts soluble in alcohol	·339	1·888
Ammonia, in the state of ammoniacal salts	·033	·184
Starch	3·507	19·537
Oil	·546	3·041
	100·005	100·025

The ash of parsnips has been analysed by Dr. Richardson, with the following results:—

Composition of the Ash of Parsnips.

Potash	36·12
Soda	3·11
Magnesia	9·94
Lime	11·43
Phosphoric acid	18·66
Sulphuric acid	6·50
Silica	4·10
Phosphate of iron	3·71
Chloride of sodium	5·54

By moistening a transverse section of the root of parsnip with tincture of iodine the external layers are coloured deep violet-blue, whilst the remaining portion of the root is not discoloured. By this means three distinct circles can be distinguished on a transverse section of parsnip: one interior, formed by the heart of the root, an exterior coloured deep violet-blue by the production of iodide of starch, and an intermediate circle between the heart and the exterior blue coloured zone. This shows distinctly that starch does not exist in the heart, nor in the layers next to it, but that it is all deposited in the external layers of the root.

On further examination of these three sections of the root, I have also found that the intermediate layers contain much more protein compounds than either the heart or the outer layers, where the starch is deposited. The intermediate portions between the heart and the outer layers, indeed, contained in this instance one-half more of flesh-forming constituents than the other portions of the roots, as will be seen from the following determinations:—

	In outer Layers.	Heart.	Layers between the Heart and the outer Layers.
Percentage of nitrogen	1·039	1·067	1·500
equal to			
Protein compounds	6·493	6·668	9·375

It is worthy of notice, that the albuminous or protein compounds are not uniformly distributed throughout the whole mass of the root. I have not examined any other root in this respect; but, judging from analogy, we may expect to find a similar distribution in other kinds of roots.

In ascertaining the nutritive value of roots, which is now usually done by the indirect method of combustion, care must be taken to obtain for analysis a fair average sample of the whole root, for the nutritive value of the root will either be stated too high or too low if the portions analysed contain more of the exterior or the intermediate portions of the root, as actually contained in the whole root. For this reason I find it advisable to prepare the sample of the root to be used for combustion, by

cutting the whole root into slices, which, on being dried, are powdered together. A fair average sample of the whole part is thus obtained for analysis, and all errors, arising from the want of uniformity of distribution of the albuminous matters in root-crops, are thereby avoided.

II. *Composition of the White Belgian Carrot.*

a. Carrots grown in 1851.

Water.—1. Dried in the water-bath fresh carrots lost 88·06 per cent. of water.

2. In a second determination 88·47 per cent. of water were found. On an average carrots thus contain 88·26 per cent. of water.

Ash.—1. 100 parts of fresh carrots were found to contain 0·74 per cent. of ash. In the dried state, accordingly, they contain 6·22 per cent. of ash.

2. In a second determination the percentage of ash in fresh carrots was ascertained to be 0·75, or in dried roots 6·56. On an average fresh carrots thus contain 0·74 per cent., and in the dried state 6·29 per cent. of ash.

Protein Compounds.—12·81 grains of dry carrots burned with soda-lime gave 1·66 grains of chloride of platinum and ammonium. 100 parts of fresh carrots accordingly contained 0·095 of nitrogen, equal to 0·596 of protein compounds; and in the dried state 0·813 of nitrogen, equal to 5·081 of protein compounds. According to these determinations the general composition of fresh carrots grown in 1851 may be represented as follows:—

	I. Experiment.	II. Experiment.	Average.
Water	88·060	88·470	88·260
Organic matters containing nitrogen, capable of producing flesh	·596	·596	·596
Substances not containing nitrogen, fitted to support respiration and for the formation of fat	10·604	10·184	10·399
Inorganic substances (ash) .	·740	·750	·745
	100·000	100·000	100·000

The dried carrot consequently has the following general composition:—

	I. Experiment.	II. Experiment.	Average.
Organic matters containing nitrogen (flesh-forming principles)	5·081	5·081	5·081
Substances free from nitrogen (heat and fat producing substances)	88·699	88·359	88·629
Inorganic matters (ash) . .	6·220	6·560	6·290
	100·000	100·000	100·000

b. Carrots grown in 1852.

Water.—1. Fresh carrots were found to contain 88·567 per cent. of water.

2. In a second experiment 100 parts of fresh carrots lost 88·867 per cent. of water. On an average the fresh carrots of 1852 growth contained 88·717 per cent. of water.

Ash.—1. In the first determination the percentage of ash in fresh carrots was found to amount to 0·697 per cent. The dried carrot accordingly contained 6·10 per cent. of ash.

2. In a second determination the percentage of ash in carrots in their natural state amounted to 0·706 per cent. In the dried state, according to this determination, carrots contain 6·26 per cent. of ash.

Protein Compounds.—15·79 grains of carrots, dried at 212° F., burned with soda-lime, gave 2·20 grains of chloride of platinum and ammonium. 100 parts of dried substance thus contain 0·875 per cent. of nitrogen, equal to 5·462 of protein compounds. In the natural state, consequently, these carrots contain 0·098 per cent. of nitrogen, or 0·612 of protein compounds. The general composition of the carrots in their natural state thus was as follows:—

	I. Experiment.	II. Experiment.	Average.
Water	88·567	88·867	88·717
Organic matters containing nitrogen, and capable of producing flesh	·612	·612	·612
Organic matters not containing nitrogen, and fitted to support animal heat and for the formation of fat . . .	10·124	9·815	9·970
Inorganic substances (ash) .	·697	·706	·701
	100·000	100·000	100·000

Dried at 212° the general composition of carrots, grown in 1852, is as follows:—

	I. Experiment.	II. Experiment.	Average.
Nitrogenised substances (flesh-forming principles) . .	5·462	5·462	5·462
Substances not containing nitrogen (heat and fat producing matters)	88·438	88·278	88·358
Inorganic substances (ash) .	6·100	6·260	6·180
	100·000	100·000	100·000

It will be observed that the composition of the carrots grown in 1851 was almost identical with that of the carrots grown in 1852. In round numbers carrots may, therefore, be assumed to

contain about 88 per cent. of water and 12 per cent. of solid matter.

Detailed proximate Composition of Carrots.

The carrots analysed were found to contain 87·234 per cent. of water in one experiment and 87·434 per cent. in a second. On an average they contained, therefore, 87·338 per cent. of water. In the following table the composition of carrots in their natural state, and dried at 212°, is represented:—

Table showing the Proximate Composition of Fresh and Dried White Belgian Carrots.

	In Natural State.	Dried at 212° F.
Water	87·338	——
Cellular fibre	3·471	27·412
Inorganic matters attached to the fibre	·145	1·145
Sugar	6·544	51·682
Salts soluble in alcohol	·409	3·230
Gum and pectin	·885	6·989
Inorganic salts insoluble in alcohol	·293	2·314
Soluble casein	·498	3·934
Insoluble protein compounds	·169	1·334
Oil	·203	1·604
Nitrogen in the state of ammoniacal salts	·008	·063
	99·963	99·707

The ash of Belgian carrots has been analysed by Professor Way, who gives the following results as representing the average composition of five analyses of the Belgian carrot:—

Silica	1·19
Phosphoric acid	8·55
Sulphuric acid	6·55
Carbonic acid	17·30
Lime	8·83
Magnesia	3·96
Piroxide of iron	1·10
Potash	32·44
Soda	13·52
Chloride of sodium	6·50
	99·94

A comparison of the composition of these white carrots with that of the parsnips, which has been stated above, suggests to us the following observations:—

1. There is a general resemblance in the composition of both roots.

2. Parsnips, however, differ in composition from white carrots chiefly by containing less sugar, the deficiency of which is replaced by starch, not occurring in carrots.

3. White Belgian carrots generally contain 5 to 6 per cent. more water than parsnips. Thus fresh carrots contain on an average but 12 per cent. of solid substances, whilst parsnips contain as much as 18 per cent. In their natural state parsnips, therefore, will be found much more nutritious than carrots.

4. The nutritive value of parsnips, in so far as it is dependent on the proportion of flesh-forming constituents which are found in the root, according to the above results appears to be greater than that of carrots. Whilst fresh parsnips contain 1·30 per cent., and dry 7·25 per cent. of flesh-forming constituents, Belgian carrots were found to contain only 0·612 per cent. of protein compounds in their natural state, and 5·46 per cent. in their dried state. Compared with other crops parsnips are about as rich in albuminous compounds as mangolds, and ought, therefore, to go as far as mangolds in producing flesh.

5. The proportion of ammoniacal salts which occurs in the parsnip and in the carrots amounts to mere traces, which do not render inaccurate the determination of the nutritive value of these roots by the indirect method of combustion. Parsnips, richer in protein compounds than carrots, also contain more nitrogen in the form of ammoniacal salts.

6. As compared with carrots parsnips contain a double proportion of fatty matters. They ought, therefore, to be superior as a fattening material in the feeding of stock.

7. The differences in the relative proportions of cellular fibre in both roots are very great. The cellular fibre occurring in carrots, parsnips, turnips, mangolds, &c., must not be regarded as useless in the animal economy, for there can be little doubt that the soft and young fibres of these roots are readily converted in the stomach of animals into gum and sugar, and applied in the system to feed the respiration, or for the formation of fat.

Thus, on the whole, parsnips appear to possess greater value than white Belgian carrots as a feeding or fattening material. Parsnips are indeed very valuable as an article of food; they are liked by cattle, and highly esteemed by Continental farmers for fattening stock. Moreover, they stand the frost better than any other root-crop, and keep well for a long time, as they contain less water than almost any other root-crop usually cultivated in England. On these grounds I would, therefore, strongly recommend the field cultivation of parsnips.

XX.—*Report on the Exhibition of Live Stock at the Lewes Meeting of the Society.* By SAMUEL JONAS.

IN writing a Report of the Show of Live Stock in 1852, the stewards have thought it best that, to aid them in arriving at a right conclusion, they should ascertain the sentiments of the judges appointed for each variety of stock. This has been done; and upon the opinions of men so competent to decide they have grounded this Report. As stewards of the show-yard, they feel it their duty to bear testimony to the great trouble taken and anxiety shown by those gentlemen who have discharged the irksome and responsible duty of adjudicating the prizes offered by this Society.

They have presented in this Report tables showing the number of each description of animals exhibited every year of the show, and also the total number of animals of each breed exhibited at the country meetings of the Society from 1839 to 1852 (both inclusive), as well as the total amount of money awarded as prizes to each description of stock in the same period. It will appear that in fourteen years this Society has been the means of collecting and exhibiting, for the benefit and improvement of those connected with the important science of agriculture, the large number of 9681 animals, many of which could not be equalled in the whole world; the Society has also distributed amongst the owners of these animals the large sum of 14,902*l.* to encourage the improvement in the breed of our domestic animals; and, as a proof of the deep interest taken in these exhibitions by the breeders of stock, they find that in the first seven years of this Society the total number of animals shown was 3612, but in the last seven years had increased to 6069. The following table will show the total number of the principal breeds of cattle and sheep, also of horses and pigs, exhibited in the first seven years, as compared with the last seven years:—

	Number of Animals shown in the principal Classes of Live Stock the first 7 years of the Society ending 1845.	Number of Animals shown in the principal Classes of Live Stock in the last 7 years ending 1852.
Short-horns	407	702
Herefords	224	211
Devons	141	357
Leicester sheep	562	1090
Southdowns	597	883
Long-woolled sheep	312	288
Horses	219	603
Pigs	350	982

Table I.—Short Horns.

Year.	Place of Meeting.	Bulls of any age.	Bulls exceeding 3 years old.	Bulls exceeding 3 and not exceeding 5 years old.	Bulls exceeding 1 and not exceeding 3 years old.	Cows in milk of any age.	Cows in milk or in calf of any age.	Heifers in calf not exceeding 3 years old.	Heifers in milk or in calf not exceeding 3 years old.	Yearling Heifers.	Bull Calves.	Total.
1839	Oxford	7	..	..	..	4	..	3	..	9	4	27
1840	Cambridge	..	7	..	11	6	..	4	..	11	8	47
1841	Liverpool	..	11	..	24	9	..	5	..	9	9	67
1842	Bristol	..	17	..	11	9	..	6	..	9	..	52
1843	Derby	..	18	..	17	17	..	16	..	11	..	79
1844	Southampton	..	18	..	21	10	..	4	..	13	..	66
1845	Shrewsbury	..	20	..	11	..	11	9	..	9	9	69
1846	Newcastle-upon-Tyne	..	27	..	29	..	19	14	..	17	9	115
1847	Northampton	..	19	..	19	..	26	9	..	19	..	92
1848	York	..	30	..	28	..	21	12	..	19	..	110
1849	Norwich	..	21	..	16	..	29	7	..	22	..	95
1850	Exeter	..	16	..	22	..	9	9	..	12	..	68
1851	Windsor	..	41	..	48	..	25	22	..	40	..	176
1852	Lewes	..	..	11	19	..	14	..	8	12	..	64

Table II.—Herefords.

1839	Oxford	6	..	..	..	6	..	5	..	3	4	24
1840	Cambridge	..	3	..	..	1	..	2	..	1	..	7
1841	Liverpool	..	8	..	3	2	..	6	..	3	5	27
1842	Bristol	..	11	..	9	8	..	5	..	5	..	38
1843	Derby	..	7	..	5	3	..	3	..	5	..	23
1844	Southampton	..	6	..	7	5	..	6	..	9	..	33
1845	Shrewsbury	..	13	..	8	..	16	8	..	13	14	72
1846	Newcastle-upon-Tyne	..	3	..	2	..	3	1	..	8	6	23
1847	Northampton	..	11	..	8	..	8	6	..	2	..	35
1848	York	..	5	..	7	..	7	5	..	6	..	30
1849	Norwich	..	5	..	7	..	3	4	..	9	..	28
1850	Exeter	..	5	..	5	..	3	6	..	6	..	25
1851	Windsor	..	11	..	8	..	6	7	..	9	..	41
1852	Lewes	..	8	8	3	..	7	..	6	5	..	29

Table III.—Devons.

1839	Oxford	4	..	..	..	5	..	2	..	2	2	15
1840	Cambridge	..	5	..	3	3	..	8	..	3	3	25
1841	Liverpool	..	3	..	3	1	..	..	..	1	1	9
1842	Bristol	..	6	..	9	17	..	6	..	8	..	46
1843	Derby	..	4	..	2	2	..	1	..	3	..	12
1844	Southampton	..	8	..	2	6	..	3	..	4	..	23
1845	Shrewsbury	..	1	..	2	..	2	2	..	3	1	11
1846	Newcastle-upon-Tyne	..	3	..	2	..	4	2	..	2	2	15
1847	Northampton	..	7	..	2	..	9	6	..	4	..	28
1848	York	..	3	..	6	..	9	5	..	7	..	30
1849	Norwich	..	8	..	8	..	11	10	..	11	..	48
1850	Exeter	..	17	..	19	..	41	25	..	21	..	123
1851	Windsor	..	9	..	12	..	15	17	..	20	..	73
1852	Lewes	..	..	5	11	..	8	..	7	7	..	38

TABLE IV.—CATTLE of any BREED or CROSS (not qualified to compete in the Classes).

Year.	Place of Meeting.	Bulls of any age.	Bulls exceeding 3 years old.	Bulls exceeding 3 and not exceeding 5 years old.	Bulls exceeding 1 and not exceeding 3 years old.	Cows in milk of any age.	Cows in milk or in calf of any age.	Heifers in calf not exceeding 3 years old.	Heifers in milk or in calf not exceeding 3 years old.	Yearling Heifers.	Bull Calves.	Total.
1839	Oxford	6	. .	. .	. .	11	. .	. .	. .	4	2	23
1840	Cambridge	. .	4	. .	3	4	. .	1	. .	4	1	17
1841	Liverpool	. .	3	. .	2	4	. .	1	. .	2	1	13
1842	Bristol	. .	11	. .	8	12	. .	4	. .	6	. .	41
1843	Derby	. .	4	. .	1	8	. .	1	. .	3	. .	17
1844	Southampton	. .	5	. .	9	8	. .	7	. .	5	. .	34
1845	Shrewsbury	. .	2	. .	2	. .	3	1	. .	3	. .	11
1846	Newcastle-upon-Tyne	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1847	Northampton	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1848	York	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1849	Norwich	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1850	Exeter	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1851	Windsor	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1852	Lewes	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

TABLE V.—CATTLE of any BREED (not qualified to compete in the other Classes, Cross-bred animals being excluded).

1839	Oxford	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1840	Cambridge	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1841	Liverpool	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1842	Bristol	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1843	Derby	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1844	Southampton	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1845	Shrewsbury	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
1846	Newcastle-upon-Tyne	. .	4	. .	5	. .	9	5	. .	4	. .	27
1847	Northampton	. .	1	. .	. .	. .	6	1	. .	2	. .	10
1848	York	. .	1	. .	. .	. .	2	2	. .	3	. .	8
1849	Norwich	. .	7	. .	3	. .	14	5	. .	6	. .	35
1850	Exeter	. .	3	. .	. .	. .	6	. .	. .	1	. .	10
1851	Windsor.	. .	4	. .	2	. .	4	3	. .	2	. .	15
1852	Lewes	. .	. .	9	5	. .	2	. .	1	. .	. .	17

TABLE VI.—CHANNEL ISLANDS CATTLE.—Special Class in 1844 and 1851.

Year.	Place of Meeting.	Bulls exceeding 3 years old.	Bulls exceeding 1 and not exceeding 3 years old.	Cows in milk of any age.	Cows in milk or in calf of any age.	Heifers in calf not exceeding 3 years old.	Yearling Heifers.	Total.
1844	Southampton	7	5	7	..	1	3	23
1851	Windsor	6	6	..	8	6	5	31

TABLE VII.—SUSSEX CATTLE.—Special Class in 1851 and 1852.

Year.	Place of Meeting.	Bulls exceeding 3 years old.	Bulls exceeding 3 and not exceeding 5 years old.	Bulls exceeding 1 and not exceeding 3 years old.	Cows in milk or in calf of any age.	Heifers in calf not exceeding 3 years old.	Heifers in calf or in milk not exceeding 3 years old.	Yearling Heifers.	Total.
1851	Windsor	4	..	5	6	3	..	4	22
1852	Lewes	..	13	10	23	..	17	12	75

TABLE VIII.—CATTLE IN SPECIAL CLASSES.—Exeter 1850 and Windsor 1851.

	South Hams Cattle. 1850.	Long Horned Cattle. 1851.	Scotch Horned Cattle. 1851.	Scotch Polled Cattle. 1851.
Bulls exceeding 3 years old .	3	1	..	1
Bulls exceeding 1 year and not exceeding 3 years old	..	1	3	1
Cows in milk or in calf of any age	6	2	4	3
Heifers in calf not exceeding 3 years old.	..	1	2	2
Yearling Heifers	1	2	..	3
Total	10	7	9	10

Table IX.—Horses.

Year.	Place of Meeting.	Agricultural Stallions of any age.	Agricultural Stallions 4 years old and upwards.	Agricultural Stallions 3 years old.	Agricultural Stallions 2 years old.	Stallions for getting Hunters, Carriage-Horses, or Roadsters, of any age.	Thorough-bred Stallions of any age.	Stallions for Dray purposes of any age.	Stallions for Hunting purposes of any age.
1839	Oxford	10	..	..	..	7	..	..	..
1840	Cambridge	19	..	..	..	10	..	..	..
1841	Liverpool	..	9	3	3	..	..	..	..
1842	Bristol	14	..	..	5	..	6	..	..
1843	Derby	13	..	..	3	..	8	..	..
1844	Southampton	13	..	..	7	..	8	..	..
1845	Shrewsbury	13	..	2	5	..	4	..	..
1846	Newcastle-upon-Tyne	21	..	8	6	..	10	..	..
1847	Northampton	17	..	2	16	..	..	..	..
1848	York	33	..	..	8	..	..	7	20
1849	Norwich	31	..	..	14	..	..	4	..
1850	Exeter	24	..	..	7	..	..	..	..
1851	Windsor	29	..	..	21	..	..	8	15
1852	Lewes	28	..	..	17	..	..	..	..

Year.	Place of Meeting.	Stallions for Carriage purposes of any age.	Stallions for getting Roadsters of any age.	Cleveland Stallions of any age.	Cart Mare and Foal of any age.	Mare and Foal for Hunting purposes of any age.	Mare and Foal for Carriage purposes of any age.	Cleveland Mare and Foal of any age.	Two-year old Fillies.	Total.
1839	Oxford	..	..	..	5	..	..	..	..	22
1840	Cambridge	..	..	..	6	..	..	..	..	35
1841	Liverpool	..	..	..	4	..	..	..	..	19
1842	Bristol	..	..	..	8	..	..	..	6	39
1843	Derby	..	..	..	8	..	..	..	2	34
1844	Southampton	..	..	..	7	..	..	..	3	38
1845	Shrewsbury	..	..	..	5	..	..	..	3	32
1846	Newcastle-upon-Tyne	..	..	..	6	..	..	..	4	55
1847	Northampton	..	..	..	12	..	..	..	4	51
1848	York	18	10	12	12	12	6	2	4	144
1849	Norwich	..	7	..	17	..	..	..	15	88
1850	Exeter	..	10	..	11	..	..	..	7	59
1851	Windsor	11	8	..	19	..	..	..	8	119
1852	Lewes	..	7	..	16	..	..	..	19	87

Table X.—Leicester Sheep.

Year.	Place of Meeting.	Shearling Rams.	Rams of any other age.	Ewes with their Lambs.	Shearling Ewes.	Total.
1839	Oxford	10	15	10	15	50
1840	Cambridge	18	18	5	10	51
1841	Liverpool	21	20	25	30	96
1842	Bristol	16	14	..	10	40
1843	Derby	35	28	..	85	148
1844	Southampton . . .	19	23	..	25	67
1845	Shrewsbury	34	31	..	45	110
1846	Newcastle-upon-Tyne .	61	43	..	70	174
1847	Northampton . . .	42	31	..	60	133
1848	York	71	48	..	80	199
1849	Norwich	46	42	..	75	163
1850	Exeter	33	32	..	70	135
1851	Windsor	68	53	..	75	196
1852	Lewes	36	19	..	35	90

Table XI.—Southdown, or other Short-woolled Sheep.

Year.	Place of Meeting.	Shearling Rams.	Rams of any other age.	Ewes with their Lambs.	Shearling Ewes.	Total.
1839	Oxford	10	15	10	35	70
1840	Cambridge	25	32	20	50	127
1841	Liverpool	17	12	5	30	64
1842	Bristol	19	19	..	35	73
1843	Derby	13	15	..	30	58
1844	Southampton . . .	51	29	..	35	115
1845	Shrewsbury	42	13	..	35	90
1846	Newcastle-upon-Tyne .	39	7	..	30	76
1847	Northampton . . .	45	15	..	55	115
1848	York	27	15	..	20	62
1849	Norwich	38	24	..	90	152
1850	Exeter	43	30	..	35	108
1851	Windsor	68	44	..	100	212
1852	Lewes	51	27	..	80	158

Table XII.—Long-woolled Sheep (not Leicesters.)

Year.	Place of Meeting.	Shearling Rams.	Rams of any other age.	Ewes with their Lambs.	Shearling Ewes.	Total.
1839	Oxford	6	5	15	15	41
1840	Cambridge	8	10	10	20	48
1841	Liverpool	6	8	15	45	74
1842	Bristol	9	6	..	25	40
1843	Derby	8	8	..	10	26
1844	Southampton . . .	13	9	..	30	52
1845	Shrewsbury	10	11	..	10	31
1846	Newcastle-upon-Tyne .	11	6	..	5	22
1847	Northampton . . .	15	11	..	15	41
1848	York	21	12	..	25	58
1849	Norwich	14	10	..	25	49
1850	Exeter	15	12	..	15	42
1851	Windsor	15	9	..	25	49
1852	Lewes	9	3	..	15	27

TABLE XIII.—MOUNTAIN SHEEP.

Year.	Place of Meeting.	Rams of any age.	Ewes of any age.	Shearling Ewes.	Total.
1845	Shrewsbury	11	..	15	26
1846	Newcastle-upon-Tyne .	28	25	30	83
1851	Windsor	13	10	20	43

TABLE XIV.—SHEEP IN SPECIAL CLASSES.

Short-woolled Sheep other than Southdowns . . Southampton, 1844.
Black-faced Sheep . . . . . Newcastle-upon-Tyne, 1846.
Cheviot Sheep . . . . . . Ditto.
Romney Marsh, or Kentish Sheep . . Lewes, 1852.

—	Short-woolled Sheep, other than South-downs. — Southampton, 1844.	Black-faced Sheep. — Newcastle-upon-Tyne, 1846.	Cheviot Sheep. — Newcastle-upon-Tyne, 1846.	Romney Marsh, or Kentish Sheep. — Lewes, 1852.
Shearling Rams	19	7	5	17
Rams of any other Age . .	14	10	..	..
Ewes of any Age	..	..	..	15
4-toothed Ewes with their Lambs	..	..	..	25
Shearling Ewes	60	15	..	..
Total . .	93	32	5	57

TABLE XV.—PIGS.

Year.	Place of Meeting.	Boars of any breed of any age.	Boars of a large breed of any age.	Boars of a small breed of any age.	Sows of any breed of any age.	Sows of a large breed of any age.	Sows of a small breed of any age.	Breeding sow pigs of any breed above 4 and under 9 months old.
1839	Oxford	8	..	..	4	..	..	12
1840	Cambridge	13	..	..	3	..	..	6
1841	Liverpool	9	..	..	3	..	..	6
1842	Bristol	24	..	..	17	..	..	27
1843	Derby	..	8	10	..	10	21	33
1844	Southampton	..	8	25	..	4	16	33
1845	Shrewsbury	..	9	11	..	3	15	..
1846	Newcastle-upon-Tyne .	..	17	22	..	15	32	..
1847	Northampton	..	8	13	..	8	9	..
1848	York	..	13	39	..	21	46	..
1849	Norwich	..	7	24	..	14	30	..
1850	Exeter	..	12	37	..	9	38	..
1851	Windsor	..	22	44	..	33	40	..
1852	Lewes	..	24	39	..	16	44	..

TABLE XV.—PIGS—*continued.*

Year.	Place of Meeting.	Breeding sow pigs of any breed above 4 and under 10 months old.	Breeding sow pigs of a large breed above 6 and under 12 months old.	Breeding sow pigs of a large breed above 4 and under 12 months old.	Breeding sow pigs of a large breed above 4 and under 8 months old.	Breeding sow pigs of a small breed above 4 and under 10 months old.	Breeding sow pigs of a small breed above 4 and under 8 months old.	Total.
1839	Oxford	..	..	..	..	..	..	24
1840	Cambridge	..	..	..	..	..	..	22
1841	Liverpool	..	..	..	..	..	..	18
1842	Bristol	..	..	..	..	..	..	68
1843	Derby	..	..	..	..	..	..	82
1844	Southampton	..	..	..	..	..	..	86
1845	Shrewsbury	12	..	..	..	..	..	50
1846	Newcastle-upon-Tyne	21	..	..	..	..	..	107
1847	Northampton	..	6	..	..	6	..	50
1848	York	..	..	9	..	30	..	158
1849	Norwich	..	..	..	3	..	33	111
1850	Exeter	..	..	..	15	..	36	147
1851	Windsor	..	..	..	27	..	57	223
1852	Lewes	..	..	..	24	..	39	186

TABLE XVI.—POULTRY.

Year.	Place of Meeting.	Cocks and Hens of the Dorking, Surrey, old Sussex, or Kent Breeds.	Cocks and Hens of the Malay, Cochin China, or other Asiatic breeds.	Cocks and Hens of the Spanish, Hamburgh, or Polish breeds.	Cocks and Hens of any other pure breed.	Cocks and Hens of any mixed breed.	Turkeys.	Geese.	Ducks of the Aylesbury or any other white variety.	Ducks of any other good variety.	Guinea Fowls.	Total.
1852	Lewes	60	48	27	27	12	3	15	22	12	0	226

TABLE XVII.—EXTRA STOCK.

Year.	Place of Meeting.	Number of animals entered.
1839	Oxford	54
1840	Cambridge	72
1841	Liverpool	76
1842	Bristol	60
1843	Derby	129
1844	Southampton	86
1845	Shrewsbury	25
1846	Newcastle-upon-Tyne	46
1847	Northampton	20
1848	York	67
1849	Norwich	30
1850	Exeter	42
1851	Windsor	..
1852	Lewes	..

TABLE XVIII.—SUMMARY of LIVE STOCK exhibited since the formation of the Society, and the Amount of Money awarded to each Class.

Description of Stock.	Oxford, 1839.	Cambridge, 1840.	Liverpool, 1841.	Bristol, 1842.	Derby, 1843.	Southampton, 1844.	Shrewsbury, 1845.	Newcastle, 1846.	Northampton, 1847.	York. 1848.	Norwich, 1849.	Exeter, 1850.	Windsor, 1851.	Lewes, 1852.	Total Number of each class.	Money awarded to each class.
																£.
Short-horns	27	47	67	52	79	66	69	115	92	110	95	68	176	64	1,027	1,885
Herefords	24	7	27	38	23	33	72	23	35	30	28	25	41	29	435	1,885
Devons	15	25	9	46	12	23	11	15	28	30	48	125	73	38	498	1,885
Cattle of any breed or cross.	23	17	13	41	17	34	11	..	..	..	..	..	..	..	156	
Cattle of any breed, cross-bred animals being excluded.	..	..	..	..	..	..	..	27	10	8	35	10	15	17	122	1,165
Channel Islands cattle	..	..	..	..	..	23	..	..	..	..	..	..	31	..	54	92
Sussex cattle	..	..	..	..	..	..	..	..	..	..	..	..	22	75	97	110
South Hams cattle	..	..	..	..	..	..	..	..	..	..	..	10	..	..	10	..
Long-horned cattle	..	..	..	..	..	..	..	..	..	..	..	..	7	..	7	30
Scotch horned cattle	..	..	..	..	..	..	..	..	..	..	..	..	9	..	9	20
Scotch polled cattle	..	..	..	..	..	..	..	..	..	..	..	..	10	..	10	35
Horses	22	35	19	39	34	38	32	55	51	144	88	59	119	87	822	1,980
Leicester sheep	50	51	96	40	148	67	110	174	133	199	163	135	196	90	1652	1,600
Southdown, or other short-woolled sheep.	70	127	64	73	58	115	90	76	115	62	152	108	212	158	1480	1,600
Long-woolled sheep, not qualified to compete as Leicesters.	41	48	74	40	26	52	31	22	41	58	49	42	49	27	600	1,425
Mountain sheep	..	..	..	..	..	..	26	83	..	..	..	..	43	..	152	140
Short-woolled sheep, other than Southdowns.	..	..	..	..	..	93	..	..	..	..	..	..	..	..	93	30
Black-faced sheep	..	..	..	..	..	..	..	32	..	..	..	..	..	..	32	Prizes included with mountain sheep.
Cheviot sheep	..	..	..	..	..	..	..	5	..	..	..	..	..	..	5	
Romney Marsh sheep	..	..	..	..	..	..	..	..	..	..	..	..	..	57	57	50
Pigs	24	22	18	68	82	86	50	107	50	158	111	147	223	186	1,332	920
Poultry	..	..	..	..	..	..	..	..	..	..	..	..	..	226	226	50
Extra Stock	54	72	76	60	129	86	25	46	20	67	30	40	..	..	705	..
Total number of animals each year.	350	451	463	497	608	716	527	775	580	866	799	769	1,226	1,054	9,681	14,902

The show of short-horns, however, at Lewes was not so good as on some previous occasions. Neither Class 1 nor 2 was so good as we could have desired. The improvement in the male animals did not strike us as being progressive; this may fairly be attributed to the alteration in the rule excluding bulls of any age, and to the distance from the great short-horn district. The females appeared to us as possessing great merit, many of them being very superior in quality and character.

In the Hereford class the stewards regretted to find so few animals exhibited, and consequently so little competition; but, at the same time, they are justified in stating that the animals shown maintained the character of this breed, and were generally of excellent quality.

In the class of Devons they had to regret the smallness of the number of animals exhibited; but, at the same time, have great pleasure in bearing testimony to the excellency of the two classes 4 and 5, in which there was evidently progressive improvement.

The show this year being held in the county of Sussex, they looked forward to see not only a good entry of the native cattle of the county, but also some of the finest specimens of the breed, in which they were not disappointed. The Sussex cattle did not disgrace their native county, but sustained a good position amongst the other breeds of cattle; and the number entered proved the great desire of the Sussex breeders to show the farmers of England then and there assembled the best specimens of their local breed of cattle. The entries in the class open for all cattle not eligible to compete in any of the previous ones were, they regret to say, very few in number; and it appeared to them that no animal exhibited possessed any great merit. This class being looked upon as the refuge for the destitute—or, in other words, the class open to all animals which are excluded from the foregoing ones—the stewards did expect to find more competition, but feel almost tempted to advise the Society for the future to discontinue the prizes in this class; still, as the object of the Society is to encourage the very best description of animals in each variety of stock, and at the same time to present our annual exhibition as a school for the general improvement of landowners and tenant-farmers, they are inclined to think that much good may be found and benefit derived by comparing the animals of various breeds in this class with the other well-known and selected varieties of stock.

The horses in Class 1, in which there were twenty-four animals entered, were generally of a superior character. Three very good ones were unsuccessful, from exhibiting characters of an hereditary disease, two having very bad feet, and the other being rejected in consequence of malformed hocks and bursal enlarge-

ments. A young horse, two years old, in this class, commended by the judges, was considered wrongly placed in consequence of his age. In Class 2 the general character of the animals shown was an improvement on former meetings. A horse in this class, of good appearance and character, might have obtained a prize, but for its action being so very bad. In Class 3 the judges did not consider the horses to be well qualified for the purpose of the Society. Classes 4 and 5 were deservedly highly commended by the judges as magnificent specimens of the kind, and showing decided improvement on previous exhibitions.

The show of Leicester sheep was considered equal to former years. The animals exhibited in Class 3 appeared superior to those of past exhibitions. The result of the judges' decision proved most fully what may be done by strict attention to breeding any description of animals, when one gentleman is found taking all the prizes ; nearly a similar circumstance having happened at the Windsor show, in the Southdown sheep. The county of Sussex being so celebrated for its breed of sheep as well as cattle, the stewards had with eager anticipation waited for the day of our show with great expectation of witnessing an extraordinary competition in the Southdown sheep. Their expectations were fully realised, as the numbers shown were large, and the competition great, the animals shown nobly upholding the fame of the Southdown sheep for perfect beauty, symmetry, and form. The long-woolled sheep, not qualified to compete as Leicesters, were very short in number, and possessed about usual merit.

The breed of Romney Marsh sheep was not very highly spoken of by the judges.

The show of pigs was large, but appeared not to be properly classed. Class 2 very good. One or two inferior animals prevented the class being generally commended. The same remarks apply to Class 3, which with Class 4 were decidedly better than at any former show. Classes 5 and 6 not so good as formerly, and the judges complain of their not being properly classed.

A new and evidently interesting feature of our exhibition was that of the feathered tribe, the judges of which expressed themselves desirous to communicate with the Society as to the future arrangements in this class.

In conclusion, the stewards may safely congratulate the members of this Society on the great improvement which has taken place in each variety of our domestic animals since the first exhibition of stock at Oxford, which improvement they feel themselves justified in attributing to the prizes offered by this Society. It has brought together in one focus the breeds and the best breeders of all our varieties of stock, thus enabling them and others to take advantage of the judgment and decision of those gentlemen

who have acted as judges at its shows, and to compare the form and symmetry, the quality and touch, of the prize animals with others in the same class. The advantage thus arising to themselves could not easily be obtained in any other way. These improvements are again spread among the great body of agriculturists, who are so enabled to participate, by improving their own flocks and herds, in what becomes an incalculable benefit to the nation at large. For early maturity and aptitude to fatten increase to a considerable extent the food of the people, and thus confer a general benefit on our common country.

The gracious interest manifestly taken by our beloved Sovereign and her Royal Consort in the proceedings of this Society, as evinced by them at the show at Windsor, proves how deeply they feel the importance of this Society and the interest of agriculture which it was formed to encourage.

SAMUEL JONAS.

Ickleton, Cambridgeshire,
Nov. 3, 1852.

XXI.—*On a Trial between the Water-drill and Dust-drill in growing Turnips.* By PH. PUSEY.

As at our annual trials of implements the delivery alone of the manure by the different drills can be tried, it seemed to me that it might be of use to farmers if I tried the comparative effect produced on the crop by the ordinary drill and by the water-drill. Accordingly, after feeding off some vetches towards the end of July, I put in two acres of turnips with Chandler's water-drill, and, within five days, four acres more with a prize turnip-drill made by Hornsby. The ground was almost too wet, so that the water-drill had no advantage on that account. The quantity of manure was the same with each; it was rather large, because the season was late, 6 cwt. of superphosphate per acre. The water-drilled turnips took the lead, and kept it in a most extraordinary way till December, when the weighing took place and the following result appeared:—

	Superphosphate.	Turnips. Tons.
Water-drilled	6 cwt.	$13\frac{1}{2}$
Dust-drilled	6 cwt.	$6\frac{1}{2}$

I cannot account for this enormous difference: I never saw so great a difference before, and should not expect it again; but after some years' experience of the two drills, I have determined to abandon the use of the dust-drill in flat-drilling and to use the water-drill only. For there is, firstly, the advantage that you

can drill in dry weather at once; 2ndly, that the manure is better diffused in the soil for each rootlet to feed upon; 3rdly, that you save the expense of the ashes required by the dry drill, say for 24 bushels of ashes, at 2*d.* a bushel, 4*s.* per acre; fourthly and lastly, that much less labour of horses and men is required with the water-drill, especially now that by means of a gutta percha pump, costing 4*l.*, which can be purchased with the drill, the boys who drive can fill the water-carts also. I find the comparative labour as follows:—

Dust-drill.			Water-drill.		
Horses.			Horses.		
4		in drill.	2		in drill.
1		fetching ashes.	2		fetching water.
1		supplying drill.			
6			4		
Men.	Boys.		Men.	Boys.	
2	1	with drill.	2	0	with drill.
4	0	mixing manure.	0	2	filling and driving water in carts.
1	1	with ash-carts.			
7	2		2	2	

If the brook be less conveniently situated than on my farm more horses and boys would be required for fetching water, but it answers to fetch the water from a good distance. One farmer in Wiltshire carries his water for the purpose two miles. The water-drill is made at present only by Messrs. Reeves, at Westbury, Wilts. It costs 25*l.* The prize dust-drill at Lewes cost 23*l.* On these grounds it appears to me that, where water is at command within a reasonable distance, the water-drill should supersede the dust-drill altogether in flat-work for turnips, such as we use in the south.

Pusey, Dec. 1852.

XXII.—*On the Neglect of Chemistry by Practical Farmers; its Causes and Remedies.* By Edward T. Hemming.

Prize Essay.

Part I.—The Causes.

Causes of Neglect.—That the practical farmer has not hitherto bestowed that attention to the study of the scientific principles of his art which the importance of the subject demands, or taken the share which peculiarly belongs to him in the advancement of the science, must, I fear, be conceded by every one. My object

in the following pages will be, in the first place, to discover the causes of this neglect by the farmer of what may be—I might almost say *must be*—of such practical advantage to him; and, in the second, how far these obstacles may be removed by means that are already in our possession.

And first let me state, for the information of those farmers who question the right of chemists to teach them, that I am no chemist, and that the knowledge of chemistry requisite for the formation of such tables as are appended to this essay, is nothing more than may be easily acquired by any farmer, with the aid of any of the many excellent treatises on chemistry that are now published. But, so far as I can understand, the fact that chemists have hitherto received so little assistance from the practical farmer, may be mainly ascribed to the following causes:—

1. The previous habits and education of the farmer not adapted to the exigencies of the times from the rapidity with which agricultural chemistry has sprung up into importance.
2. Mistrust in the minds of farmers, caused by the practical failure of many theories which had been too rashly and dogmatically asserted as facts by chemists and others.
3. The liability to error, from the great caution necessary in drawing deductions from any experiment in practical agriculture, and the difficulty of ascertaining the amount of dependence to be placed on it, from the variety of influences that may affect the result obtained.
4. The few opportunities that the generality of farmers have of selecting the most trustworthy analyses, or of estimating the degree of dependence that may be placed on any analysis, by comparing it with similar ones, made by different chemists; on account of their being scattered through so many different works.
5. The labour required to reduce them when found, to a state in which they may be of any practical service, from the fact of chemists not adhering to one uniform standard, or calculating the results of their researches in a practical form.
6. The impossibility of making any practical use of many of the analyses, published for the benefit of farmers, on account of the chemist having omitted to state the *proportion of ash* contained in the substance analyzed, when in its natural state.

Cause 1.—"Previous Habits and Education of Farmers," &c.—The British farmer of the last generation would have laughed at the idea of learning anything of farming from books; he felt that he had gained the proud pre-eminence of being the best practical farmer in the world, and therefore, he thought that the system he had inherited was perfection, and that all that was necessary for his son was, to follow faithfully in his steps (and it must be allowed that the son has well sustained the reputation of the father); so that, instead of keeping him at school longer than was necessary to learn the mere rudiments of general knowledge, he early withdrew him, in order to instruct him in all the then known mysteries of practical farming. Hence it arises that the

present race of farmers, taking them as a class (for, of course, there are *many* exceptions), have acquired no habits of literary occupation, and that some of them even look down upon those who so far forget the "good old ways" as to show any desire to make themselves acquainted with the strange facts that are every day being announced. That this is not wholly an imaginary statement, I think may be deduced from the fact, that the prize for the best system of farming accounts offered by this Society was obliged to be withheld on account of the want of merit among the competitors; and where figures are at such a discount, a corresponding deficiency in other departments of literature is naturally implied.

This, I fear, presents an almost insurmountable obstacle to the rapid advance of scientific research among the present generation of farmers; for although most of them are ready to take advantage of any practical discoveries that may from time to time be made, they necessarily find it, at their time of life, difficult to apply themselves to the study of a new science requiring all the energies of youth. But even among those who have been so fortunate as to have received a good education in their youth, an idea sometimes prevails, that it would be quite useless for them to attempt to master the principles of such a mysterious science as chemistry, particularly when they read the hard names that are applied to the various substances, so different to anything that they have been accustomed to heretofore. I need not say that this fear is perfectly groundless, as a very short trial on their part would prove to their own satisfaction.

I now come to consider another cause, which has had great influence in deterring many, who otherwise were quite willing, from pursuing their inquiries on this interesting subject, and has placed a powerful weapon in the hands of those who are advocates for the "good old ways." I refer here to the subject-matter contained in

Cause 2—viz.: "The rash assertions made by chemists and the friends of progress, without first having determined whether such assertions are practically correct, or based on solid foundations." Under this head I fear I must include Liebig himself, the father of agricultural chemistry; for the practical failure of his patent manure caused a reaction in the minds of farmers against the teachings of chemistry, almost as strong as the feelings which his original work, together with the introduction of guano, had raised in its favour. If, instead of telling farmers that he had discovered the grand panacea for farming, whereby they would be enabled to grow any crop on any ground, and as often as they liked, he had said "The deduction that I draw from my scientific researches is, that the inorganic portion of a crop is the only part necessary to

be restored to the land in order to produce a similar crop. I now ask the practical farmer to determine whether my theory is practically correct"—In this case the farmer would have reported that it was not *practically* correct; but the result would not have shaken his confidence in the chemist, as the above-mentioned failure evidently did.

The manner, too, assumed by many chemists, is too dogmatic to be very palatable to a farmer, who justly prides himself on knowing something of the art he follows; and although I have no wish to defend prejudice, I must say it was fortunate for the farmer that he did not alter his practice on the announcement of every new theory, as in this case, I fear, he would be more out of pocket than he is, unfortunately, at present. Chemists have been too apt to treat farmers as a set of school-boys, who had only to believe what was told them, whether it agreed with their experience or not; and if they demurred, they were immediately charged with being ignorant and prejudiced, in place of being asked for their co-operation to test in the field the practical truth of theories constructed in the closet. Nor was consideration taken of the injury that may be inflicted on a cause, by leaving it in the power of its opponents to convict its advocates of an unfounded statement.

Cause 3—viz.: "The liability to error, from the great caution necessary in drawing deductions from any experiment," &c.

Not only is the chemist exposed to error in the laboratory, but the farmer is even still more liable to error, in ascertaining the amount of dependence that may be placed on any experiment in the field; for if we take the simplest case, as, where the farmer wishes to determine the comparative effects of any special manures by leaving portions of the same field in an unmanured state, the varying composition of the soil, even when supposed to be perfectly similar, is found to be a fruitful source of error, as we may easily discover by referring to the many series of experiments that are recorded in the 'Quarterly Journal of Agriculture,' where two portions of unmanured ground in the same field are often found to give a widely different amount of produce. But this cause of error is comparatively unimportant, when compared with those which may arise where a farmer tests for himself the value of any manure which he may have heard has been very successful in some other locality, and perhaps highly recommended by some chemists, on scientific principles. In case it should not succeed with him, he immediately condemns the manure, and most probably regards all science with reference to agriculture as deceptive, not taking into consideration, or perhaps not knowing, under what circumstances of soil, climate, previous cropping, &c., the

successful crop may have been grown; for his soil may, perhaps, have a superabundance of the very mineral ingredients which the manure in question principally restores to the ground; whilst in those cases wherein it succeeded, it is reasonable to suppose that there might have been a total deficiency, or, at any rate, that the quantity present was not in a fit state to be assimilated by plants, not to mention the immense influence which a difference of season exercises upon the amount of produce, as Mr. Lawes has clearly demonstrated in one of his contributions to the Journal of the Royal Agricultural Society of England.

The above considerations show some of the many practical difficulties that occur to impede the onward progress of the science of agriculture on sure and unerring principles.

Cause 4—viz.: "The want of some work wherein might be collected the various trustworthy results obtained by different chemists, at present scattered through so many works," has the effect of retarding the progress of the science, by the perpetuation of error; for from the fact of the farmer not possessing the means of selecting or comparing different analyses, he naturally places implicit belief in the correctness of those that may happen to come under his notice, although perhaps they may have long since been shown to be quite erroneous, and unworthy of credit. In some of the popular periodicals connected with agriculture I have even found that those who profess to instruct the farmers are often content to take the first analyses that come to hand, without troubling themselves to inquire as to their correctness. But supposing the farmer to be so fortunate as to have access to trustworthy data, the evils arising from

Causes 5, 6, viz.: "The labour and knowledge necessary to recalculate some analyses into a practical form;" and "the impossibility of making any use of others;" are sufficient to counteract most of the good that may be supposed to arise from this circumstance, as the two following examples will show:—

Suppose the case of two chemists, having each analysed a portion of the same piece of limestone, to determine the quantity of lime in it, one of whom recorded his results in the form of salts, whilst the other gave the amount of proximate elements; the one might then state that he had found 98 per cent. of carbonate of lime in the stone in question, but the other would say that it contained 55 per cent. of lime. Now the reader unacquainted with chemistry would naturally infer that the one analysis indicated twice the amount of lime of the other, although they are merely two different forms for expressing the same result. And even if we suppose him to know a little of chemistry, he would not be able to compare the two results until he

had calculated the amount of lime present in the 98 per cent. of carbonate of lime.

Again, to show how a mere analysis of the ash, without giving the proportion of ash contained in the original substance, so far from assisting farmers, may tend much more towards misleading them, I will suppose, for example, that the amount of lime contained in the ash of two different plants (A and B), in A was stated at 20 per cent., and in B at only 5 per cent. The farmer here, on casting his eyes over the two analyses, would at once imagine that a crop of the plant A required four times as much lime as one of B; but if we suppose a given weight of the plant B to contain four times as much ash as the same weight of the plant A, the amount of lime required by *equal weights* of the two plants would be exactly the same.

Here, again, we are impressed with the necessity of calculating the amount of ingredients contained in a ton, or an average crop of any plant per acre; for though equal weights of the two plants in question may contain an equal amount of lime, yet the produce of B per acre may be ten times as large as that of A, and therefore would require ten times as much lime as A, although the first impression, caused by an inspection of the analyses of their ash, was, that A would require four times as much as B.

These cases must not be considered as merely imaginary or rare exceptions, for I have in my own experience often found farmers falling into these errors.

I believe that heretofore no one has attempted to lighten the labour of calculation necessary to reduce the results as published to a form in which they may be of practical service to the farmer, if we except the Table on the constituents of crops, compiled by Dr. Daubeny, from 'Analyses' by Sprengel, and published in a former volume of this Journal. This is the more to be deplored, for the labour, not to mention the expense, that is required to pursue any inquiry to a satisfactory conclusion is so great, that one can scarcely be astonished to find that many a farmer, who may have had his curiosity excited by some exceptional occurrence, should afterwards relinquish the prosecution of it on account of this very difficulty, particularly when we remember their proverbial distaste for calculation. I have now briefly noticed the causes which appear to me to exert the greatest influence in retarding the spread of the study of chemical agriculture among farmers; and in the following pages I purpose inquiring how far it may be in our power to provide remedies for this existing state of affairs with the materials at our command.

Part II.—The Remedies.

In treating of the means whereby the cause of agricultural chemistry may be materially advanced, I intend adhering to the same order as in the preceding part, discussing each head separately.

Remedy for Cause 1.—With respect to the improvement of the education of the farmer, this must, of necessity, be a work of time, although I think that there is good reason for believing that the desire for information is extending itself daily among this class, as is evidenced by the firm hold that the Royal Agricultural Society of England, and other kindred Societies, have taken on their sympathies; the appointment of a consulting chemist to each of the principal Societies of the United Kingdom, particularly showing the advance that must have been made by farmers generally, so far as expressing a wish to be better informed on this interesting subject. The number of lecturers, too, who are daily disseminating the first principles of this interesting science, in terms adapted to the comprehension of their hearers, must also have an important effect in awakening a desire on their part to follow up the study of it, and test for themselves the truth of what they have been told; to assist all such in their inquiries I have added simple explanations of the chemical terms, and the method of using the tables appended to this Essay. The increasing number of schools wherein instruction is now given in agricultural chemistry, shows that even those who may at the present time be too far advanced in age to apply themselves to a new study, are seeing the necessity of having their sons instructed in the principles of this science; so that with respect to the rising generation of farmers, I trust that the preceding remarks will cease to be applicable. For those, however, who may have already turned their attention to the study of the science of farming, it becomes the more necessary that we should do all in our power to make the way as easy as possible, and I confidently hope that these tables will be found, in some degree, to have accomplished that object.

Remedy for Cause 2.—The remedy for the evils arising from the rash assertions and dogmatic manner of chemists, must depend upon the chemists themselves, for the science of agriculture will never advance as it ought until the chemists, as a class, remember that their duties consist not so much in instructing the farmer as in prosecuting and extending our present knowledge of the science "*by the aid* of the intelligent farmer," as Liebig has well expressed it, for which purpose our agricultural institutions are so admirably adapted.

The following extract from an able essay by Dr. Anderson, successor to Professor Johnston, as chemist to the Agricultural

Society of Scotland, on the 'Relations of Science to Practice in Agriculture,' places my view of the question in so strong a light that I have no hesitation in quoting it:—"The true manner in which chemical agriculture is to be advanced, is not merely by the exertions of the chemist or the labours of the laboratory alone; it must be by the simultaneous efforts of science and of practice, each endeavouring to develop, with care, steadiness, and accuracy, the facts which fall within its province; nor must each pursue its own course irrespective of the other. They must go hand in hand, and taking advantage of each other's experience, and avoiding all sort of antagonism, they must endeavour to co-operate for the elucidation of truth. The chemist and the practical man are, in fact, in the position to give each other most important assistance. The one may point out the conclusions to which his science, so far as it has gone, enables him to come; while the other may test these conclusions by experiment, or may be able from his experience at once to refute or confirm them. But it will not do to imagine that there is here either a triumph or defeat. Such a spirit cannot be anything but injurious. It is rather to be looked upon as a fortunate state of matters, which, admitting of the examination of our conclusions from two different points of view, directs us with the greatest certainty in the path of truth."

I will merely add on this subject, that the manner in which Professor Way conducts his investigations, and draws his conclusions from them, appears to me a perfect model for other chemists, from the cautious process by which he advances step by step; for, instead of asserting anything authoritatively, he points out to his readers the reasons pro and con, and wherefore he inclines rather to the one side than the other.

Remedy for Cause 3.—In the preceding part I have shown the many difficulties that the practical farmer has to encounter in testing the theoretical conclusions of the chemist by experiment in the field, and the necessity of using the greatest caution, before either condemning or placing too implicit reliance on any theory. There is, however, a means, with the assistance of some such tables as are annexed to this Essay, whereby the observant farmer may considerably advance the science of agriculture, and that not so much by making any direct experiment, as by noticing those exceptional occurrences which often arise in the common course of his farming experience, and which may be viewed in the light of experiments conducted by the hand of nature: and there is one great advantage in these inductive experiments, viz., that they do not entail that expense and trouble which must necessarily be incurred for analyses, &c., when an experiment is tried in a direct manner, and which alone is a sufficient reason to account for the fact of so many farmers rather trusting to the experiments of others

than trying any for themselves. Perhaps I may make my meaning better understood by recounting one of these experiments of nature that happened on our own farm, and which, in fact, was the immediate cause of my compiling these tables, from the difficulty I encountered in collecting the various data together, and then reducing them to a practical form. In the autumn of 1846 a field of about 3 acres was manured at the rate of 20 tons of farm-yard manure per acre, and sown with rye for soiling in the following spring. It produced a very heavy crop, but on account of the stalks becoming too hard for the horses, we were obliged to allow half the rye to remain for seed. The part of the field which had been soiled was immediately ploughed, and sown with globe turnips, with a dressing of 3 cwt. of Peruvian guano per acre. The turnips were very fine, and obtained a prize at our local show. After the seed-rye was harvested and the turnips cleared, the whole 3 acres were ploughed, and set with beans in the following February; and now comes the curious part of the affair: the beans came up well over the whole field, but we soon began to perceive a difference between those on the seed-rye and turnip-ground, the former looking much more luxuriant than the latter, but we were not prepared for what afterwards took place. The beans that followed the turnips actually stopped all growth when 6 *inches* high, and of course did not seed, whereas after the seed-rye they grew so luxuriantly as to injure the produce, and this difference extended to the line where we had discontinued cutting the green rye, the more conspicuous as we had stopped in the middle of our land.

This result certainly astonished me, for it was in direct antagonism to all the preconceived notions of farmers, as it is usually thought by them that crops do not draw the ground, nearly to the same extent, when cut green, as when allowed to ripen their seed. Turnips, too, are generally supposed to extract the greater portion of their nourishment from the atmosphere.

But here we find that beans actually refused to grow after the green rye and turnips, notwithstanding the application of 3 cwt. of guano, and the land being in much better tilth; while where the rye was allowed to ripen its seed, and no extra manure applied, they grew luxuriantly.

I determined to inquire whether the researches of chemists would throw any light upon the question, and the difficulty I had in compiling the following small table, fully accounts to my mind for the fact that chemistry has hitherto received so little assistance from practical farmers.

Probable Amount of Ingredients abstracted from or restored to One Acre of Land, by the several Crops and Manures of Rotation 1. (Seeded Rye and Beans.)

For One Acre of Land in lbs.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Sand Silica.	Potash.	Soda.	Lime.	Magnesia.	Oxide Iron.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
Amount added to soil by farm-yard manure	3320	400	2380	180	3305	140	40	280	20	40	..	60	140	80	?
Ditto by seed rye	56	6	53	2	0.2	0.7	..	..	0.3	..	..	..	1	..	..
Total amount added for rye crop .	3376	406	2433	182	3205	141	40	280	20	40	..	60	141	80	?
Amount abstracted by rye crop .	2169	245	1868	34	65	25	0·1	10	5	2	..	1	14	1	..
Balance after rye crop . . .	1207	161	565	148	3240	116	40	270	15	38	..	59	127	79	?
Amount added by seed beans . .	101	15	86	13	..	3	..	1	1	..	..	..	2	..	..
Total balance left for bean crop .	1308	176	651	161	3240	119	40	271	16	38	..	59	129	79	?
Amount required by bean crop. .	?	?	?	164?	7	55	8	37	11	2	..	16	29	8	36
Balance	?	?	?	−3	+3233	+64	+32	+234	+5	+36	+	43	+100	+71	?

Rotation 2. (Green Rye, Turnips, and Beans.)

For One Acre of Land in lbs.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Sand Silica.	Potash.	Soda.	Lime.	Magnesia.	Oxide Iron.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
Amount added to soil by farm-yard manure	3320	400	2380	180	3305	140	40	280	20	40	..	60	140	80	?
Ditto by seed rye	56	6	53	2	0.2	0.7	..	..	0.3	..	..	..	1	..	..
Total amount added for green rye crop	3376	406	2433	182	3305	141	40	280	20	40	..	60	141	80	?
Amount abstracted by green rye crop	1499	168	1233	12	63	17	..	9	2	1	..	1	4	1	?
Balance after green rye crop . .	1877	238	1200	170	3242	124	40	271	18	39	..	59	137	79	?
Amount added by 3 cwt. of guano .	?	?	?	48	5	10	4	38	2	1	..	7	49	13	?
Total balance left for turnip crop .	?	?	?	218	3247	134	44	309	20	40	..	66	186	92	?
Amount abstracted by turnip crop .	?	?	?	159	..	166	5	102	6	..	..	44	33	55	82
Balance left after the two crops .	?	?	?	59	3247	−32	39	207	14	40	..	22	153	37	?
Amount added by seed beans . .	101	15	86	13	..	3	..	1	1	..	..	..	2	..	..
Total balance left for bean crop .	?	?	?	72	3247	−29	39	208	15	40	..	22	155	37	?
Amount required by bean crop . .	?	?	?	164?	7	55	8	37	11	2	..	16	29	8	36
Balance	?	?	?	−92	+3240	−84	+31	+171	+4	+38	..	6	+126	+29	?

When we come to compare the balance left in the soil after these two rotations, supposing the bean crop to have succeeded in both, we find that with the green rye and turnips there is a larger deficiency both of nitrogen and potash, that of the latter amounting to 84 lbs. per acre; or, in other words, the soil would have had to supply 84 lbs. of potash, in addition to that supplied by the manure, in order to grow a crop of beans, whereas in the rotation where the rye was allowed to stand for seed, there was a large excess of potash, and a sufficiency of nitrogen.

The obvious deduction from the above calculation is, that the bean crop failed after the turnip crop for the want of either nitrogen or potash, or both combined, the soil not being able to supply the deficiency; but, nevertheless, I should hesitate to assert it as a positive fact, unless confirmed by a number of similar observations, for it must be borne in mind, that we cannot be too cautious of jumping to a conclusion in these matters, particularly when we remember the comparatively imperfect materials that are at present at our command for determining fairly the average composition of every crop.

I am sorry that it was not in my power to verify the truth of the above deduction, by the application of some salts of potash and ammonia, both separately and conjointly; but the land coming in for green crops again, it was prepared by trenching 20 inches deep, which, of course, would prevent any fair deduction from being drawn afterwards, whatever might have been the result of the experiment.

Some, perhaps, may object that these results are not to be depended upon, inasmuch as the identical crops themselves were not subjected to analysis, nor even their produce actually weighed; but for my part, I think a general average analysis is quite as likely to be correct for a whole acre as a single analysis, though made of a plant growing upon that very acre. Of course, no dependence can be placed upon a slight variation only, as all the *acreage* quantities are but approximations to the actual weights. I think, however, that a number of facts, exhibiting such marked results as the above, when brought to bear on one another, would probably be of some service, in enabling us to grope our way along the obscure path of theory.

Should, however, a greater degree of exactness be desired, we may readily obtain it by burning a small given weight of the crop, &c., and thereby calculating the actual amount of ash contained in one acre of the crop, &c., whence we may easily estimate the probable quantity of each individual ingredient contained in that amount of ash.

Again, as the labour of making direct experiments is very great, and sufficient of itself to deter many farmers from interest-

ing themselves on the subject, were they always *to leave a small strip of ground unmanured*, whenever any special manure was applied to the rest of the field, they would, after some time, be able to estimate roughly the comparative value of the different manures, so far as their farm was concerned; and then, by some such process as that just detailed, discover, perhaps, the cause of the one manure being so superior to another, and *vice-versa.* And thus, perchance, the practical farmer may be enabled to devise some theory for the nutrition of plants which may entirely accord with practice, as it must be allowed that this subject is still in a state of doubt and perplexity. At any rate, a collection of such observations and deductions could not but be a valuable contribution towards the advancement of the science.

Causes 4, 5, 6.—*Labour of Calculations, &c.*—In the tables appended to this essay I have endeavoured, to the best of my ability, with the materials at my command, to rectify all the evils arising from these causes;—in the first place, by placing side by side the mean results obtained by different celebrated chemists (completing the analysis when deficient in any part by the same means when analysing the same substance), whereby the farmer will be enabled to judge to what extent he may be entitled to rely upon the facts there stated, when applied to practice; and, secondly, by calculating the results that may be deduced from any analysis, in four different forms, viz.:

1. Showing the composition per cent. of both the organic and inorganic portion of the substance analysed, for the purpose of calculating the *probable* amount of the various constituents, organic and inorganic, in any other specimen of the substance, where the proportion between the organic and inorganic portion differs from that in the one that has been subjected to analysis.

2. The entire composition per cent. of the whole substance analysed, including the water natural to it, indicating the quantity of any ingredient contained in 100 parts of the whole substance, as the number of grains in 100 grains, lbs. in 100 lbs., or tons in 100 tons.

3 and 4. The amount contained in one ton and one acre, respectively of the crop, &c., in its natural state of dryness, the object in calculating the amount per ton being, that thereby any farmer may at once be enabled to determine the amount per acre in his locality, that being necessarily an ever-varying quantity.

I think that by means of these tables the labour of calculation, which has hitherto, probably, deterred many farmers from investigating these questions, will now be so lightened that we may hope hereafter to receive valuable assistance from the great body of farmers; and although we may not be able clearly to define the actual benefits that may accrue to the class by their

investigation, even the practical farmer need not, I think, be afraid of being considered a theorist, should he believe it probable that some good might arise from the united observations of farmers, when compared with the researches of chemists, particularly when we call to mind the great revolution that has already taken place in farming during the last few years, caused by the introduction of guano, and the practical discovery by Liebig of the superphosphate of lime; which latter, as though to show of what service chemistry may ultimately prove to practical agriculture, is now largely manufactured from fossil coprolites.

But I also venture further to think that I can show that such tables as these may be of great use, even to those who may be too prejudiced to believe that any good can possibly arise from the before-mentioned researches, and this by affording a standard, by means of which the genuineness of any manure, &c., may be ascertained. Take the case of guano, for example (for I suppose that even the *most practical* farmer makes use of this manure). If the farmer, before making a large purchase, were to have a sample analysed by some competent chemist, the charge for which would be comparatively trifling, he would, by comparing the result obtained with the mean composition of the guano of similar description, as given in these tables, be able at once to discover whether it had been adulterated, or if it exceeded an average guano in value, on account of the larger proportion of valuable ingredients present; and that this caution is not wholly unnecessary, is evidenced by the statement of Professor Way, wherein he asserts, that thousands of pounds are annually expended by farmers in the purchase of spurious manures. One specimen that he analysed, and which was extensively sold at £8 per ton (the price of guano), consisted of nothing more or less than *pounded red sandstone;* in fact, manufactories are known to be springing up daily, for the sole purpose of compounding such spurious manures.

In conclusion, I have to beg for the kind indulgence of my readers, with respect to any accidental errors that may be discovered in these tables, and would feel obliged if they would forward an account of the same, with a view to their correction; for although I have taken the precaution of testing the correctness of the reductions of nearly all the *analyses* and tables that I have referred to (which I found necessary, from the numerous misprints and other errors I discovered in them), yet the fact of my being obliged to do so, gives me the less confidence in the absolute correctness of my own figures; in fact, it is nearly impossible to avoid all error in a work involving such a mass of calculation; and this being the first attempt at arranging methodically the various subjects connected with the chemistry of agriculture, it

is hardly to be expected that imperfections and omissions have been altogether avoided.

Explanation of the Tables.

The course I intend to pursue in my remarks on these Tables is—

1st. To describe the object of each form of the series.

2nd. The meaning of the terms used in the heading of the tables in the order in which they appear, explaining, at the same time, the principal properties belonging to the different chemical bodies referred to, as also showing the uses to which they are commonly applied in the arts and manufactures, in order to impress upon the minds of those of my readers who may not heretofore have been conversant with the chemical names of these bodies, that they are identically the same substances, whether found in the ashes of plants or bought in a chemist's shop.

3rd. To illustrate, by a few examples, the method of calculating the various tables, and the uses to which they may be applied.

Tables A, B, C, D.—These four tables comprise the whole series of crops commonly grown on the farm, viz., corn crops, root crops, hay and soiling crops, and miscellaneous crops; the latter being a collection of those crops that are only grown in particular districts, or not included in the preceding tables.

Each class of crops is calculated in four different forms.

Form 1.—Composition of each portion per cent., showing the quantity of each ingredient in 100 parts, by weight, of either the organic or inorganic portions.

Form 2.—Entire composition per cent., showing the quantity of each ingredient in 100 parts, by weight, of the whole plant, including the water natural to it.

Form 3.—Entire composition per ton, in lbs., showing the number of pounds weight of each ingredient contained in one ton of any crop, or part of a crop.

Form 4.—Entire composition per statute acre, in lbs., showing the amount of each ingredient in pounds weight contained in an average good crop per acre.

Form 1.—The first form is necessary for the means of easily estimating the probable composition of any specimen, when the relative proportions of the organic and inorganic portions differ from the one analysed; as also for instituting a comparison between the actual composition of either portion of any crop, either of the same or different species, as any difference between the relative proportion of either the water, organic matter, or the ash in the second part of these tables, would cause an *apparent* difference in their composition, as given in Parts 2, 3, and 4, although

each portion by itself might be identically the same, and *vice versa.*—(*See* Example.)

Form 2.—The second form is useful from the facility it affords of calculating the composition of any given weight of the crop by means of decimals.—(*See* Example.)

Form 3.—The object of the third form is so obvious as to require no comment. It is the one that will probably be most serviceable to the farmer, enabling him to determine the number of pounds of any ingredient contained in a ton of produce, and thence, by a simple calculation, the number of pounds per acre when the amount of crop is known.—(*See* Example.)

Form 4.—The intention of the fourth form is more to show, by example, the method of comparing the average composition of crops with one another, or with the manure supplied to them, than to infer that such are the actual fixed quantities on an acre of ground, for every farmer must be aware that it would be manifestly impossible to give such an amount of produce to each crop as would suit every locality and every season. My aim has been to give what I consider an average good crop under high farming and in a suitable climate, &c. By the preceding part of the table, however, the farmer will have no difficulty in calculating the amount contained in any acre of his crops, according to his own experience of their produce.

In explaining the terms used in these tables I intend taking them in the order in which they appear in the headings.

Class.—In arranging the order of the various crops I had a choice of three methods of classing them, viz., the alphabetical, the botanical, or the agricultural. I have adopted the latter course as possessing manifest advantages over the other two, in enabling the farmer to see at a glance the difference in composition of crops that are often substituted for one another in a rotation.

General Division—Water, Organic Matter, Ash.—This is the first and simplest determination of the three parts that all plants are composed of, and may easily be performed by any farmer, with the aid of a good pair of scales. The specimen to be analysed is supposed to be perfectly dry and clean, as far as any accidental moisture or dirt is concerned. If it be then subjected to a boiling heat, in an open vessel, from which the steam can escape, until it lose no more weight, the loss incurred is the weight of water natural to that quantity of the specimen operated upon; and if the now dry specimen be burnt (taking care not to lose any of the ash), the difference between its weight before and after combustion is the amount of organic matter contained in the specimen, the remainder being the ash, or inorganic portion; and of course the three quantities obtained will, when

added together, equal in amount the weight of the original specimen.

Organic, or Combustible Matter—Ultimate and Proximate Elements.—Having in the preceding paragraph explained the meaning of the term organic matter, we now come to consider of what it is composed. Chemists have two different modes of recording the results of their analyses, the one giving the ultimate elements, and the other the different forms in which these ultimate elements are combined in the matter analysed.

Ultimate Elements.—Ultimate elements are those simple substances which are not susceptible of any further decomposition, and in all organic matter they consist of carbon, hydrogen, oxygen, and nitrogen.

Carbon.—Pure carbon is found in its solid state only in the diamond, which is entirely composed of crystallized carbon. Common charcoal is principally composed of carbon, and for all practical purposes may be considered as identical with it, though it has generally a varying amount of hydrogen and oxygen in union with it, in addition to its mineral ash. The form in which it is assimilated by plants is probably that of carbonic acid, being a union of carbon and oxygen (existing, when uncombined with other substances, in the form of a gas). This gas is the bad air we exhale from our lungs, and is identical with that which collects in mines, wells, &c., and so often occasions fatal accidents on account of its not being either a supporter of life or combustion. It is also found in soda-water and all other effervescing and fermenting beverages.

Hydrogen.—This element, when uncombined, exists in the form of a gas, and is used for the inflation of balloons, being the lightest substance known. In union with oxygen, in the proportion of 1 to 8 by weight, it forms water; in combination with carbon it forms the highly explosive gas so much dreaded in mines, called fire-damp, and the common coal gas, with which the streets are lighted.

Oxygen.—This element, whose natural state, when uncombined, is also that of a gas, is the chief supporter of life and combustion. In mechanical mixture with nitrogen, in the proportion of 8 oxygen to 28 nitrogen by weight, it forms the common air we breathe, and in chemical combination with hydrogen, as previously stated—water. No animal, plant, or flame can exist without it.

Nitrogen.—Nitrogen, or azote, is chiefly distinguished by negative qualities, such as being incapable of supporting either combustion or animal life; its use in common air appears to be to dilute the powerful effects of the oxygen gas. In an agricultural point of view, this may be considered the most important of the *organic* gases.

Having now described a few of the principal properties of the bodies comprising the ultimate elements of organic matter, we have to notice the forms and properties they acquire when combined as proximate elements, for it must be borne in mind that the two states are never co-existent in the same substance, but that the latter are the tangible forms in which the former combine.

Proximate Elements.—Proximate elements are those into which a compound body is resolved by the first operations of analysis: they are classed as—

Azotised.—Azotised, or nitrogenised, which signifies that they contain nitrogen as well as the other three organic elements; and

Unazotised.—Unazotised, or unnitrogenised, when nitrogen is absent.

Ammonia.—This gas is not an ultimate element, being a compound of nitrogen and hydrogen; and yet it can scarcely be considered as a proximate element, when viewed in connexion with the others under this head: I have therefore given this column an intermediate place between the ultimate and proximate elements, as will be seen by reference to the table. This gas is sometimes called the volatile alkali, and must be well known to all farmers, it being the cause of the pungent odour that pervades an ill-ventilated stable, and of the strong smell from guano; it is a product of all animal and many vegetable substances when in a state of putrefaction: it is highly volatile, as its common name implies, but has a great affinity for water, which tends to fix it, if in sufficient quantity. I need not mention here the powerful effect it has in promoting the growth of plants. The common smelling salts are composed of ammonia and carbonic acid.

It is not intended by the quantities given in this column that the actual quantity of ammonia there stated is present in the crops, but that when decomposed the said crops would generate that amount; or, in other words, that that amount of ammonia would be required to supply the nitrogen in the crops, supposing, with Liebig, that all the nitrogen is assimilated in the form of ammonia, and that none is lost.

I have now to describe the properties of the proximate elements, in the general acceptation of that term.

Albumen, Gluten, Casein.—These three azotised proximate elements invariably contain a small quantity of free sulphur, and, according to Liebig, the vegetable albumen is identical in properties and composition with the animal albumen as contained in the white of an egg, or the serum of blood; the vegetable gluten, with the fibrine of blood; and the vegetable casein, with the casein of milk. The whole of these substances are supposed by chemists to be nearly, if not quite, identical in composition;

and the reason of their having received different names is on account of their different appearance and action towards re-agents. And these facts have led Liebig to believe that we may estimate the flesh-producing power of any crop by the quantity of azotised proximate elements contained in it. My object in giving these proximate organic analyses is to test the truth of this theory by the practical experience of farmers; of course, in investigating this question allowance must be made for the various feeding habits of different species of animals, as also for the different degrees of digestibility of the food.

But here let me caution my readers against placing too much dependence on these proximate analyses when the result of a single analysis only, for it must be allowed that chemists up to this time have not acquired such proficiency in this department of their science as they have in the ultimate organic and inorganic analyses, which latter fact has caused the majority of chemists to estimate the amount of azotised proximate elements from the previously ascertained quantity of nitrogen contained in the crop in question. This they are easily able to do, for as each of the azotised proximate elements contains about 15·75 per cent. of nitrogen, if we multiply the amount of nitrogen contained in the crop in question by $\frac{100}{15 \cdot 75}$ or 6·35, it will, of course, give us the *total* amount of azotised proximate elements; though for all practical purposes I think that we might omit the decimals, and merely multiply the nitrogen by 6. In all doubtful cases I would certainly recommend this method of calculating their amount to be adopted.

Fat, Oil, Starch, Gum, Sugar, Fibre.—These are the unazotised proximate elements of vegetables, containing no nitrogen. The four latter are combinations of carbon, with oxygen and hydrogen, in the proportion in which they form water, and as they are capable of being transformed from one to another, their different forms are not always distinctly defined. The fatty oils differ from the preceding, in being principally composed of carbon and hydrogen, with a much smaller proportion of oxygen. Liebig supposes that these unazotised proximate elements are the fat and heat producing portion of the crop. I leave it to the intelligent farmer to decide whether the theory is tenable, merely premising that the fibre must be kept out of their calculations on account of its indigestibility.

Inorganic Portion, or Ash.—We now come to consider the inorganic portion, or ash—in other words, the part that is not dissipated by the action of fire. This when analysed is found to consist of about 13 elements, more or less, including alumina, manganese, and carbonic acid; the presence of the first of these in

plants, however, is considered *very* doubtful by chemists; the second occurs only in very minute quantities, and is often disregarded; whilst the third, carbonic acid, being really an organic compound, is only inserted because it is always present in the ash whenever any organic acids existed in the plant previous to combustion, and therefore becomes necessary to be taken into account, in order that the correct amount of the other ingredients may be determined.

I have adopted the plan of Professor Way, resolving the salts into their proximate elements in those analyses where a different arrangement had been adopted, as by giving the amount of each individual element a comparison between any two analyses can be instituted at once. It must not, however, be supposed that the elements exist in this isolated condition in the ash of plants, for the acids mentioned are always combined with the alkalies, or earths, in which form they are commonly termed salts of the earth, or alkali. The silica, or as it is often named silicic acid, is also generally found in combination with an alkali and earths.

Total Sulphur.—This column has been inserted on account of a late discovery by Professor Way, that in the act of burning substances for the purpose of analyses, in some instances a large amount of sulphur was found to have been dissipated, but as the means employed for ascertaining its amount before combustion are inadequate to determine the state in which it existed in the substance, whether as wholly sulphuric acid or in part free sulphur, it became necessary to state the result under the latter head. (I may here mention that dry sulphuric acid contains 40 per cent. of sulphur.) It follows, then, from the above fact, that all the analyses in these tables that are not corrected for this loss of sulphur are erroneous in that respect, and it certainly must be considered as fortunate if this, the only error that Professor Way could detect, be the only real error; for if phosphorus, in the state of phosphoric acid, were acted upon in the same way by heat, which Professor Way does not think is the case, it would cause one of the most important columns to the practical farmer to become utterly valueless.

It must particularly be remembered, in using these tables, that this column is *in addition* to the remaining constituents of the ash, except that it includes the sulphur of the sulphuric acid mentioned there. It is calculated from the *whole plant*, and therefore it must not be imagined that the ash left by burning contains that percentage of sulphur.

In Part I. of each of these tables, for instance, the quantity of sulphur stated under this head is the amount contained by the whole plant, or part of a plant, when dried at 212° F., supposing none to be lost in the operation of drying, and not in 100

parts of the ash; and in the other 3 parts it is the amount contained in 100 parts, ton, &c., of the whole substance, *in its natural state.* To prevent any mistake I have enclosed this column in double lines.

Sand and Silica.—The reason for placing sand and silica, instead of silica alone, at the head of this column, is, that a minute quantity of extraneous dirt often adheres to the specimen, notwithstanding all the precautions of the chemist; and when the amount of oxide of iron, as well as the silica, appears to be much above the general average, it may confidently be referred to this cause, although there be nothing recorded under the head of alumina—for many chemists now never test the presence of alumina in plants, from a belief that its presence is merely accidental.

Silica, Silicic Acid, or pure Flint, is a white, inodorous, insipid earth; it is seen nearly pure in rock crystal, and in its ordinary state is insoluble and infusible, but when combined with an alkali, in certain proportions, is soluble, and in others fusible as in common glass. The shining coat on the straw of cereals is nothing but a species of glass. Silica is now often termed an acid, on account of its similarity to the other acids, in its action upon the alkalies and earths, destroying their corrosive property, &c. The compound formed by its union with any substance is called a silicate of that substance.

Potash, Soda.—These alkalies are so similar in their appearance, that when in a state of purity it is quite impossible, by inspection, to distinguish one from the other; but when in union with the *same* acid the salts they form are very different, both in appearance and properties. Their principal use in the arts is in the manufacture of soap and glass. The potash and soda which are so commonly used for domestic purposes are combined with a variable small proportion of carbonic acid.

The potash of commerce is procured chiefly from the burnt ashes of plants, which fact of itself ought to be sufficient to impress upon the minds of farmers the identity between the constituents of plants and the same substances of commerce. Soda is principally obtained from common salt, as also from kelp and barilla.

Lime.—The common lime used in agriculture is not quite pure, as will appear by referring to the analyses of chalk and limestone in these tables, but for all practical purposes it may be so considered, and its properties are so well known by farmers as to require no further description here. I may add, that slacked lime is lime in combination with water, called by chemists hydrate of lime; and so great is the affinity of lime for water, that it has been found by experiment that 1 ton of fresh-burnt lime increases daily 1 cwt. in weight for the first five or six days, by the absorption

of water from the atmosphere, a fact that may be of some practical importance for farmers to know. Gypsum is lime in combination with sulphuric acid; when burnt it is termed plaster of Paris. Lime in combination with phosphoric acid forms the principal ingredient in bones, so valuable as a manure.

Magnesia—Is very similar both in appearance and properties to the preceding when in its caustic state. The form of its salts, however, is very different; Epsom salts, for instance, doubtless well known to most of my readers, is magnesia in union with sulphuric acid, a very different salt from gypsum, mentioned above.

Alumina, or pure clay, is a colourless, insipid, insoluble powder; it has a strong attraction for moisture, which it rapidly absorbs, to the amount of one-third of its own weight. When mixed with water it is characterized by the plasticity of the mixture. It is soluble in most acids, and in alkaline solutions. In a crystallized state it is seen in the sapphire, ruby, and topaz. Common clay has, comparatively speaking, but a small amount of pure alumina in its composition (*vide* Analysis). Alum is a combination of alumina, potash, and sulphuric acid.

Oxide of Iron, or rust of iron, occurs generally in the form of protoxide (black rust), or peroxide (red rust), but chemists generally calculate its amount in the latter form, although Professor Johnston has proved that it is present in soils in both forms. Green vitriol is iron in combination with sulphuric acid.

Oxide of Manganese.—There are five oxides of manganese, although it is generally estimated by chemists as peroxide. From all that is at present known on the subject, it does not appear to possess much interest for farmers, its presence in those ashes where it has hitherto been detected, being probably accidental.

Chlorides of Potassium and Sodium.—These salts used formerly to be termed muriates, but are so only when water is present, the hydrogen of the water uniting with the chlorine, forming muriatic acid, and the oxygen with the metals (potassium, &c.) forming potash, &c. Chloride of sodium is *pure dry* common salt; the salt in common use has a slight admixture of magnesia, &c. (*Vide* Analyses.)

Chloride of potassium is sometimes found in rough saltpetre (nitrate of potass), and is often taken for common salt.

In some of the analyses the reader will observe that the amount of chlorine only is given, and I had some idea of resolving the chlorides into their simple elements, in order to reduce all the analyses to one standard; but, upon second thoughts, I determined not to do so, principally on account of the interest attached to the quantity of common salt contained in any plant. By the Table of Chemical Equivalents appended to these explanations, the reader

will easily be enabled to reduce them whenever necessary. As a general rule for practical purposes, the amount of chlorine given in the analysis may be doubled, in order to obtain the equivalent of chlorides, subtracting an equal quantity from the soda.

Phosphoric Acid.—This acid, which appears to exert such a powerful influence on agriculture, is, according to Brande, composed of 1 equivalent of phosphorus and 2½ of oxygen; Liebig, while retaining the same proportions, states it as consisting of 2 equivalents of phosphorus and 5 of oxygen, or, in other words, as twice the weight. In reducing the phosphates (when necessary) in these tables, I have adhered to the formula of Brande, as being supported by analogy; for by the adoption of Liebig's formula we should be obliged to consider the *neutral* phosphates to be constituted of 1 atom of acid and 2 atoms of base, whereas, according to Brande, the neutral salt would be composed of 1 equivalent of each. In other words, the salt that is commonly termed a bi or superphosphate, is by Liebig quoted as a neutral phosphate. And this leads me to state, that from the vague manner in which chemists, in their analyses, class all salts formed by this acid as phosphates, instead of specifying what particular salt of phosphoric acid is intended, whether subphosphate, neutral phosphate, or superphosphate, it is utterly impossible for any one to determine the exact amount of acid contained in the salt in question. However, in far the greater number of cases, the acid was separated from the base by the analyst himself, but in those that were not so determined, I have always calculated the amount of acid as though the salt was neutral, according to Brande, except when it had a known composition as in bones, &c. Liebig certainly asserts that the phosphates in the cereals are bibasic salts (neutral according to Brande), and in beans and peas tribasic (or, according to Brande, subphosphate); but there is not sufficient evidence to show that they always are present in these forms, for in the same sentence in which Liebig states this as a positive fact, he also as positively states that silica and carbonic acid are *never* found in beans and peas, which fact Professor Way has certainly disproved (*vide* Analyses). This I think will show that even to chemists these tables may be useful, seeing the danger of hazarding a decided assertion without sufficient data to verify it.

Sulphuric Acid.—This acid is composed of 1 equivalent of sulphur and 3 of oxygen in its dry state (in which state all acids are estimated in all analyses); it has a powerful affinity for water. The sulphuric acid, or oil of vitriol of commerce, is combined with 1 equivalent and upwards of water. Its salts are termed sulphates. As mentioned under the head "Total Sulphur," the amount stated in the column headed "Sulphuric Acid" does not

always show the whole sulphur contained in the specimen; in some instances the quantity lost during combustion being very considerable.

Carbonic Acid.—The principal properties of this acid are described under the head of "Carbon." It is a product of the combustion of organic matter, indicating the amount of organic acids that previously existed in the plant, in union with various bases. Some chemists omit this acid altogether in stating the result of their analyses, on account of its being an organic compound, and therefore the reader must not always infer that there is none present in the ash when a blank occurs under this head. The surest method of discovering whether it is really absent, or merely an omission of the chemist, is, by examining the analyses of those chemists who always give the amount when present. This omission in analyses for practical purposes is greatly to be deplored, as it prevents any correct estimation of the quantity of the various ingredients from being obtained from the amount of ash, the result being above the true quantity. In proportion to the quantity of carbonic acid contained in the ash all the calculations in these tables, where this is the case, are necessarily erroneous to that extent.

Having now glanced at the composition and peculiar properties of the various substances referred to in these tables, there remain but the two small columns, next to the classification of the plants, to be noticed. The reader will perceive that their heading is not always the same, but the only two that require any remarks are those headed "Proportion per Cent." and "Specific Gravity."

Proportion per Cent.—The numbers given under this head express the relative proportions by weight of the several parts of the plant, as, for instance, the grain, straw, and chaff of wheat. Supposing the whole plant to equal 100, they are the actual mean proportions of the specimens analysed, as found by the chemist. The reader will perceive that in Part 4 of these tables I have not adhered to these proportions in my calculations. My reason for so doing was, not that I doubted the superior accuracy of the chemist's scales when compared with the farmer's, but that I thought it probable that the specimens sent for analysis might not include any light ears, &c., and therefore not be a fair average of the field.

Specific Gravity.—By this term we mean the ratio of weight to bulk; the specific gravity of bodies gives the relative weights of equal bulks of those bodies, water being the standard. It is determined by weighing a substance first in air and then in water; and then dividing its original weight by that of the weight which it lost in water.

Suppose, for instance, a substance weighing 456 grains in air to lose 76 grains by immersion in water, the specific gravity of that substance will be $456 \div 76 = 6$.

It is evident that by weighing any given measure of two substances we do not obtain the actual relative weight of equal volumes of those substances, for their weight greatly depends upon the amount of interstices formed by them; for instance, a bushel of meal by pressure may be made to equal in weight 2 bushels when lightly filled, although of course the weights of equal quantities are the same; in other words, their specific gravities always remain constant.

In concluding my remarks on these tables, I may state that the numbers placed against the analyst's name, refer to the number of individual specimens analysed, and not to the number of times an analysis may have been repeated, in order to verify its results.

I will now endeavour, by a few examples, to illustrate the method of using and calculating these tables.

Examples of Forms 1 *and* 2.—Given the quantity of any ingredient in 100 parts of the ash, to find the quantity of the said ingredient contained in the ash of 100 parts of the entire specimen.

Suppose, for instance, the ash of wheat grain to contain 47 per cent. of phosphoric acid, as given in Boussingault's analysis in Table A 1, and that it was required to know how much was contained in the whole grain, supposing it to be composed of 12.0 water, 86.2 org. mat., and 1.8 ash.

To determine this, all that is necessary is, to multiply the quantity found in 100 parts of the ash by the amount of ash in the specimen, and then divide by 100. Thus we have—

> 47.0 (the amount in 100 parts of ash) $\times$ 1.8 (the amount of ash in wheat grain) = 84.6, which, divided by 100, gives 0.846 as the amount of phosphoric acid contained in 100 parts of the whole grain of wheat, in its natural state of dryness.

By this means, Form 2 was calculated from Form 1.

Again: Suppose it was desired to ascertain the amount of phosphoric acid in the whole wheat grain, where its proportion of ash was 2.0 per cent., supposing its ash to be similarly constituted to that in the preceding example. Here—

> $47.0 \times 2.0 = 94.0$, which, divided by 100, gives 0.94—the amount required.

By inverting the calculation, the converse problem may be

solved thus:—Quantity contained in ash of specimen × 100 and ÷ amount of ash in specimen = amount of ingredient in 100 parts of ash.

Example 2.—To show the necessity of Form 1, in order to be able to institute a comparison between the composition of the dry matter of any two substances, suppose the organic matter of wheat grain and turnip-bulb to contain in each 2 per cent. of nitrogen; required the amount of nitrogen per cent. in the whole grain and turnip-bulb, the wheat containing 87 per cent., and the turnip-bulb 9 per cent. of organic matter, in its natural state.

Here, as in the previous case, we multiply the nitrogen by the amount of organic matter in the specimen, and divide by 100.

> 87 (organic matter in wheat), × 2 (nitrogen in 100 parts of organic matter) = 174, which, divided by 100, = 1.74, the quantity of nitrogen contained in 100 parts of the whole wheat grain.

Again: 9 (organic matter in turnip) × 2 (nitrogen in 100 parts of organic matter) = 18, which, divided by 100, = 0.18, the quantity of nitrogen contained in 100 parts of turnips.

Here we see, that although, by Form 2 of these tables, it would appear that turnip-bulb contained scarcely 1-10th part the quantity of nitrogen that the same weight of wheat grain did; yet, by referring to Form 1, we find that their respective organic matter contains the same amount of nitrogen.

Example 3.—To determine the actual relative amount of either organic matter or ash, in any two specimens.

Suppose, for example, the one specimen to contain 20.0 water, 79.0 organic matter, 1.0 ash, and the other to be composed of 10.0 water, 88.9 organic matter, 1.1 ash, and that it is desired to ascertain the relation that exists between these two substances, when the variable amount of water is left out of consideration.

The method of ascertaining their relative proportions when dry, is as follows:—

Multiply the amount of organic matter, or ash, by 100, and divide the amount by 100, minus the quantity of water contained in the original specimen, and the converse problem, viz., "to find their proportion when any given quantity of water is present, from their proportion when dry," is solved by inverting the preceding method, viz., multiplying by 100, minus the given quantity of water, and divide by 100.

In the case in question, where it is required to find their proportion when dried, at 212° F., the operation would be as follows:—

79.0 × 100 = 7900, which ÷ 80 (100 quarts of water) = 98.75 – the amount of organic matter in 100 parts of dry substance.

1.0 × 100 = 100, which ÷ 80 (100 quarts of water) = 1.25 – the amount of ash in 100 parts of dry substance.

In the second substance we have—

88.9 × 100 = 8890, which ÷ 90 (100 quarts of water) = 98.77—as the quantity of organic mater in 100 parts of dry substance.

1.1 × 100 = 110, which ÷ 90 (100 quarts of water) – 1.23 – the amount of ash in 100 parts of dry matter.

Here we see that these two specimens are almost identical in their composition, although the impression that would be left by a cursory examination would lead one to suppose that they greatly differed in their organic matter.

Had I made a greater difference in the amount of water contained by each, the effect would have been still more striking.

The following example will show the means afforded by Form 2, for facilitating calculations by means of decimals.

Example 4.—Suppose the quantity of lime contained in 100 lbs. of oat straw to be 0.48 lbs. (vide analyses); required the quantity contained in 1750 lbs.

Here all we have to do is to multiply—

1750 by 0.48, and divide by 100; or, in other words,
17.5 × 0.48 = 8.4, gives the amount required.

These examples are, I think, sufficient to show the object of and method of using Parts 1 and 2 of these tables. As regards Parts 3 and 4, the method of calculating them is so obvious as scarcely to require an illustration, the rule being to multiply the quantities contained in 100 parts of the specimen in its natural state of dryness, by 2240, the number of pounds in a ton, and divide the amount by 100, which operation is performed at once by multiplying by 22.4. This gives the number of pounds weight of any ingredient that is contained in one ton of the substance: the only difference, when the weight is required in the produce of 1 acre, is, that we multiply by the number of pounds contained in that produce, instead of the number in 1 ton, and divide by 100, as before. The following example will suffice to show the method of using these two forms:—

Example to Form 3.—Required the quantity of azotised organic matter contained in 4 tons of beans. By referring to

Part 3 of Table A, we find, under this head, that, according to Professor Johnston, 1 ton of beans contains 677 lbs. of azotised matter, and therefore 4 tons would contain $677 \times 4 = 2708$ lbs. = 1 ton, 4 cwt., 20lbs.

Example to Form 4.—What is the amount of mineral ingredients abstracted from 1 acre of soil by a good crop of wheat, according to Professor Way?

By referring to Part 4 of Table A, we find that the

Grain abstracts	. . . . .	33 lbs.
Straw "	. . . . .	151 "
Chaff "	. . . . .	49 "
	Total	233 lbs.

abstracted by entire crop.

I have added, at the end of these explanations, a small table, showing the equivalent value of the decimal part of a ton or pound, in cwts. and ounces respectively, for the sake of diminishing the labour of using these tables.

Tables E, F, G, H.—The only respect in which these tables, comprising the whole series of manures, differ from the preceding is, in the addition of columns showing the degree of solubility of the organic and inorganic portions, and the omission of those devoted to the organic proximate elements, which latter are only interesting as far as feeding is concerned; for I believe that it is now generally admitted, that plants have not the power of assimilating any of them, until decomposed into their ultimate elements.

The Soluble Organic Matter—shows the amount of organic acids, when determined, which are either soluble in water or solutions of an alkali. The principal form in which this soluble organic matter comes under the notice of the farmer, is that of humic-acid, which causes the deep beer-colour which is observable in mountain streams, that flow through peat, after heavy rains. In this state, the humic-acid is combined with ammonia, a very soluble salt, the ammonia being derived from the rain-water, from which it is never absent. Doubtless many of my readers may have noticed springs gushing from the mountain-side, which always preserve their crystal clearness, although running through the same peaty soil. The explanation of this fact is, that the spring-water is impregnated with lime, which forms with the humic-acid an insoluble salt, and therefore does not discolour the water; thus fully accounting for the great benefit that newly-reclaimed peat soils receive from the application of

lime, as thereby the *excess* of humic-acid, that is always present in such soils and is so hurtful to vegetation, is neutralised and rendered inert, in the form of an insoluble salt.

Soluble Salts.—The reader will notice that, in the heading of the soluble salts, rain-water is mentioned, and not simply water.

Rain-water.—My reason for so doing, although it has never been adopted by agricultural chemists, has been, that the farmer, in his farming operations, has only to deal with this kind of water, with regard to his manures, &c. ; and, from the fact of its always containing some carbonic-acid dissolved in it, its solvent powers are far greater than those of *pure* waters—so much so, that it has been proved that scarcely any rock can withstand its influence, when continued through successive ages.

I have not, however, noticed this latter power in arranging the degrees of solubility of the different salts, but have only included those which are so readily soluble as to be available for the farmer's present use.

Abundantly, Sparingly, &c.—I have divided them into the 'abundantly' and 'sparingly' soluble salts.

The first is supposed to include the sulphates, phosphates, and carbonates of the alkalies ; the chlorides, sulphate of magnesia, and sulphate of iron, and phosphoric acid in the state of a super-salt. The sparingly soluble include silica, sulphate of lime, carbonate of lime, and carbonate of magnesia. Phosphate of lime is very sparingly soluble in rain-water, but I have not considered it sufficiently so to be classed with them. The carbonates are totally insoluble in pure water, but are readily soluble when combined with an extra dose of carbonic-acid ; and therefore the degree of solubility they possess in rain-water depends upon the amount of carbonic-acid that it may hold in solution.

It must be remembered, that the analysts against whose names these quantities appear, have not themselves stated the amount of the soluble salts, and I have been guided solely by the names of the salts, as given in their analyses, and therefore they may not be always *practically* correct.

It is certainly greatly to be desired that chemists should give more attention to this hitherto neglected part of their investigation, as, from all that we know at present (though the present researches of Professor Way on the absorbent powers of soils with regard to manures, may throw some light on this obscure subject), it appears that the soluble salts alone are in a fit state to be assimilated by plants.

Form 4.—There is a slight variation in the title of the fourth part of the table on 'Liquid Manures.' Instead of giving the

amount of ingredients contained in the quantity usually applied to 1 acre—a quantity that in many instances it would be impossible to estimate—I thought it preferable to give the composition of 1000 gallons of each species of manure, since by this, on the preceding part, the farmer will be easily enabled to calculate the amount contained in any given quantity of manure, whether he has been accustomed to estimate it in gallons or tons.

The farmer must not consider these liquid manures of little importance on account of the small proportion of matter contained in them; for it must be remembered, that although the quantity is small, it is *all* in a state to be at once assimilated by plants—that is, as far as our present experience on this subject extends.

Table I.—The form of this table is identical with Tables A, B, C, D, and therefore needs no further notice here. I may add, however, that whilst the proximate elements are supposed to indicate the feeding properties of the articles in this table, the inorganic matter at the same time points out the probable increased value of the manure.

I have included in this table many articles that are not at present used for feeding purposes in England, but the late revolution in our commercial policy has made it not improbable that we may import many of them.

Tables K, L.—These tables are only calculated in one form, on account of the practical impossibility of giving a fair average of the water contained in them, from the fact of there being no stated period of growth at which they are made use of by farmers; this is, however, of the less importance, as it is in the form of ashes they are generally applied to the ground.

Liebig asserts that the younger the wood the greater the amount of ash; the young shoots, for instance, containing a much larger quantity than the parent stem.

In calculating from these tables for practical purposes, the farmer must make due allowance for the dirt, or unburnt matter, that may be present in his ashes.

Tables M, N.—Although these tables have more interest to the speculative chemist than the practical farmer, they are nevertheless necessary to the completeness of this work, as showing the connection that exists between the composition of the various crops raised by the farmer, and of the materials from which all soils are composed; they may also be useful in enabling the farmer to make a rough guess at the probable composition of his soil, when he has ascertained to what geological formation it belongs.

The various specimens in these tables are supposed to be perfectly dry, the quantities given under the head of 'water' indicating the amount of 'water of crystallization.'

I have considered them wholly insoluble, although water, impregnated with carbonic-acid, has been proved to have the power of slowly dissolving them; but this operation is too slow to be of much practical benefit to the occupying farmer, notwithstanding that by this agency a large proportion of existing soils have been created.

Table O.—It cannot be said of this table, as of the preceding ones, that it has but little interest for farmers, for all the earths mentioned in it are in universal use, and great interest at present attaches to the fossils lately discovered in such large quantities in the green sand formation, which are now extensively manufactured into a valuable manure, under the name of coprolites. This fact alone ought to be a sufficient answer to the query, 'What good has chemistry done the farmers?' The composition of known good tile clays may also be useful at this time, when draining operations are being carried on so extensively; as, by comparing the analysis of any clay with which it was desired to make tiles, with these, the landlord, or whoever might be interested in the question, could judge whether the manufacture would probably be successful, and if not, whether the composition of the clay might not be so altered by washing the sand out, or otherwise, as to render it so.

Tables P (1, 2).—These tables constitute a large collection of analyses of the various kinds of soils; and although there is much too great a variation between any two soils which farmers would class together for any average to be drawn that would at all approximate to the truth for any similar kind of soil, as far as our present knowledge extends, the textural difference not always agreeing with the difference in composition; yet I think that they will be found both interesting and useful to the practical farmer, and show the necessity, or at any rate the advantage, of having an analysis made of each individual soil and subsoil on their farms.

The first division shows the composition of the various soils as classed by farmers.

The second has reference to the various peculiarities noticed in some soils, such as clover failing, crops rotting, &c.

I leave it to the intelligence of my readers to determine whether the given composition of the different soils accounts in any degree for the peculiar behaviour of the crops grown on them, as my object in this work is merely to state facts (and facts as undeniable as any that the most practical farmer can adduce) and not to build any theories of my own upon them, which might probably be erroneous.

The form of these tables is identical with Tables E, F, G, H, with the exception of the two small columns headed "Coarse

gravel or sand" and "Fine matter." These are intended to show roughly the textural differences of the soils, the "Fine matter" being the impalpable matter that is separated by washing, and the "Coarse matter" the remainder.

I have also given the quantity of each ingredient contained in one acre of the soil, to the depth of one foot, when dried in the air, in order that the practical farmer may form some idea of the extensive manner in which Nature carries on her operations; indeed, I have no hesitation in asserting that there is not any one who could form the slightest conception of these quantities by a mere inspection of the proportional parts in 100, as given in an analysis. I have taken for the basis of my calculation the mean specific gravity of sixteen different soils when dried in the air, as ascertained by Dr. Krocker, and published in the last edition of Liebig's work, which gives 3000 tons, more or less, as the weight of one acre of soil, one foot deep, when dried in the air. I am aware that this result more than doubles the usual estimate of Professor Way, which is, that one inch of soil weighs 100 tons per acre; this I think may in some degree be accounted for by supposing that Professor Way's estimate refers to a soil in its natural state when cultivated. Mr. Hall, of Liverpool, was, I believe, the first person to draw attention to the necessity of showing the amount of each mineral ingredient contained in one acre of soil; and the conclusion that some writers have drawn from the fact, that a very minute decimal proportion per cent. amounts to a very considerable weight in pounds when calculated for an acre, is, that the analyses hitherto published have not been sufficiently minute, even when calculated to three places of decimals.

There seem at first sight strong grounds for agreeing with this proposition; but when we come to consider that it would be manifestly impossible to obtain a small portion of soil for analysis, however carefully mixed, that should be a perfect average of the whole acre; and also that no analysis of a few hundred grains, however carefully performed, can be *absolutely* depended on to more than the first place in decimals; the opposite conclusion would appear to be nearer the truth, that to calculate to more than one place of decimals is a waste of time for all practical purposes, and also tends to encourage a false confidence in the results. In the case of the soluble salts and of other important ingredients that may exist only in very minute proportion (generally recorded as a "trace"), it might perhaps be as well to operate upon a much larger quantity of the soil, in order that a sufficient quantity of the salts, &c., might be obtained, to give trustworthy results; when again analysed, to show the individual

salts of which they are composed. The case of the analyses made by Mr. Hunt, noticed in the Essay, will, I think, bear out the above observations.

At any rate, from the above facts it appears that a large margin must be allowed when consulting any of the quantities given in these tables per acre, as at the best they can only be considered as approximations to the truth, allowance being made for the amount of extraneous water in the soil, as also the state of tilth it might be in.

It must be borne in mind that it is only the soluble portion that has any *present* interest to the practical farmer, which leads me to notice a great oversight that chemists have (nearly without exception) committed in their analyses of soils, for the benefit of practical farmers, in merely giving the total amount of the salts that are abundantly soluble in water instead of specifying each individual salt; while, at the same time, they have often spared neither time nor trouble in ascertaining the composition of that portion of the soil which was difficultly soluble or insoluble in acids, and which, comparatively speaking, possesses but slight interest to the *practical* farmer.

Dr. Daubeny has shown, by some experiments in the Botanical Garden at Oxford, that the amount of ingredients soluble in water that remained in the soil, after a severe cropping for ten years, without the application of any manure, was incomparably smaller than that which was present in another portion of the same soil which had not been thus exhausted, while there was no appreciable difference in the quantities of the remaining constituents. The theory he deduced from these experiments was, that those salts which are capable of being dissolved by *rain* water are available for the *present* use of the farmer (these he terms the "active" ingredients of the soil); that those constituents which require muriatic acid to dissolve them *may* become serviceable to the farmer at some future time (these he calls "dormant"), whilst the remainder, which he designates as the "passive" ingredients, and which are insoluble in muriatic acid, he considers will *never* be available to the farmer, for the present generation at least. Knowing these facts—for who can doubt their truth?—it certainly does seem extraordinary that chemists should have passed over this most important element of their research, and have devoted so much of their time and energies to the investigation of that part of the subject which there seems reason to believe will never be of any practical use to the farmer (mind I am speaking here only of agricultural chemists).

There is one exception only in all the analyses collected in these two tables, and that has been made by Dr. Richardson,

and was not published till the commencement of this present year, in the 'Quarterly Journal of Agriculture;' but by some means or other he has, I think, made a serious error, in calculating from his results the quantity contained in an acre, which I have taken the liberty of correcting in this table.

In those analyses, when the amount of alumina greatly exceeds that found in similar soils, it may generally be inferred that the portion of the soil insoluble in acids has been submitted to analysis, which would also probably increase the relative amount of the other constituents when compared with other soils; but in the majority of cases in these tables the matter insoluble in acids is included with the sand and silica.

In the second series of soils I have collected together various analyses that bear upon particular questions of interest to farmers, in order to see whether any light would be thrown upon them by chemistry, as they have confessedly puzzled all *practical* farmers. But, for the reasons stated above with respect to the method of analysis adopted by chemists, should but little light be thrown upon these subjects by the analyses in question, chemistry must not rashly be condemned. The soils formed from disintegrated rocks are interesting, as showing the relation that exists between the original rocks (by reference to that table) and the soils formed from them.

Table Q.—This last table is intended to show, by an example, the practical use to which the collection of analyses contained in these tables may be applied.

The question asked in this case was, "What amount of oil-cake, per acre, must be annually purchased in order to supply the loss of mineral ingredients incurred by the sale of all the grain only, when either of the rotations mentioned in the table are followed, no other manure being purchased?"

The answer obtained is, that 5 cwt. per acre would amply supply the loss of mineral ingredients incurred in either case.

But let it be understood that by this example I do not mean to infer that it would be necessary to import that quantity of oilcake upon a farm in order to maintain its fertility; this is a question only to be determined by practice in the present state of our knowledge, since the amount of active ingredients stored in the soil may vary immensely on different farms; and for that reason I have in this example placed at the head of it the quantity of soluble ingredients contained in one acre of a soil, on which the application of alkaline salts alone was found not of the slightest service to the crops, whilst the soluble phosphates, applied in the shape of bones dissolved in sulphuric acid, exerted the greatest influence on the crop, which consisted of hybrid turnips, as by

means of a similar analysis of their own soils farmers may judge how far any ingredient may be dispensed with in the manure, on account of its abundance in the soil, and *vice versa*.

The practical correctness of this result, obtained from theoretical deductions, has been curiously verified by a report, published since this was written, on the system followed by Mr. Hudson, of Castle Acre, who imports annually upwards of 200 tons of oil-cake, in addition to special manures for all his turnips, on an arable farm of 1200 acres.

There is one slight error in this table, and that is, I have omitted to deduct the amount of seed sown from the produce of the crop, the balance only being the real loss that the land has sustained.

It is of no importance as regards a hypothetical case, but when calculating the amount for actual crops, this item must not be forgotten.

The intelligent reader will no doubt be able to ask himself and answer many other questions of a similar nature which may occur to him, without the assistance of further examples, such as the different exhausting powers of various rotations, the difference to the succeeding crop by pulling or feeding off a crop of turnips, the money value of any manure to the farmer, calculated from the market value of its constituents, &c. In fact, the questions of interest that these tables will, it is hoped, throw some light upon are so numerous, that it would require almost as many tables as are already contained in this work to illustrate each one by an example.

General Remarks.—In consulting the tables, the reader must not be surprised at finding that the aggregate weight of the individual ingredients sometimes exceeds the given amount of ash, and in other cases falls short of it; this arises from my having adopted the rule, now almost uniformly followed by scientific writers, of giving the actual amount of each ingredient, as found in the analysis, and referring the deficit or overplus to loss or gain incurred during the operation of analysis, instead of doctoring the results, by dividing the loss or overplus, as the case may be, amongst the various ingredients, and thereby giving a fallacious appearance of accuracy to the tables. The amount of loss or gain in any instance may be taken as a measure of the general accuracy of the analysis.

In conclusion, I may state that in apportioning the space to each subject I was actuated only by what I considered their relative importance to the farmer, and not by the number of analyses obtainable of any individual specimen, and in all cases my object has been to compare the results obtained by different

distinguished chemists with one another, in order that the farmer may be able to form some opinion as to the degree of reliance to be placed upon the results there stated; but when there appears to be any great discrepancy, I would advise him to select those that are the mean of the greater number of analyses; and, other things being equal, I would prefer the analyses made by our own chemists, not from any national vanity, but from the fact of their time being wholly devoted to agricultural subjects, and also from the superior facilities afforded them by the various agricultural associations that are at present established in this country.

Some of my readers may perhaps object to the numerous blanks that occur in the tables as being a waste of space, but I would suggest that even these blanks may serve a useful purpose, in directing the attention of chemists to those subjects which have hitherto been passed over in their investigations, and also in showing at a glance the amount of attention that any subject has, up to the present time, received at their hands.

For instance, Table A, on Corn Crops, has scarcely a vacant line, whilst the analyses of Miscellaneous Crops are few and far between, thus showing that the former subject, as was to be expected, has received by far the larger share of the chemist's attention.

It may also be contended that as these analyses, when by different authorities, have not been made upon the same identical specimen, we have no right to assume that the respective composition of organic and inorganic matter remains the same when their proportion to one another varies. There certainly is some show of reason in this objection; but although there never was, perhaps, any plant or other substance composed exactly of the proportions given in these tables, yet if the analyses hitherto published are to be of any practical service in aiding us to draw general deductions as to the average composition of substances, they must be considered to apply to all cases alike.

I trust that the preceding remarks have been sufficiently explicit to enable the general reader fully to understand the object and use of these tables, as I did not feel warranted in devoting a greater space to chemical explanations, considering the number of excellent elementary works that have already been published on the subject, to which I beg to refer any of my readers who may wish to enter more deeply into these investigations.

Additional Tables.—I now append two tables, the former of which will be found useful in reducing the decimal parts, as given in the tables, into their equivalents of the weights commonly used, and the second for reducing any analyses that are recorded in the form of salts to the standard employed in these tables.

Table I.

Showing the amount in Cwts. and Ounces respectively, of the decimal parts of a Ton and of a Pound.

Decimal Part.	Cwt. per Ton.	Ounces per Ton.
0.1	2	$1\frac{3}{5}$
0.2	4	$3\frac{1}{5}$
0.3	6	$4\frac{4}{5}$
0.4	8	$6\frac{2}{5}$
0.5	10	8
0.6	12	$9\frac{3}{5}$
0.7	14	$11\frac{1}{5}$
0.8	16	$12\frac{4}{5}$
0.9	18	$14\frac{2}{5}$

Table II.

Table of the Chemical Equivalents, or Atomic Weights, of the Bodies referred to, or connected with these Tables, showing the definite proportions, in which, as simple or compound bodies, they unite with each other, their respective proportion per cent., and also the composition of the latter.

Name.	Atomic Composition.	Atomic Weight.	Composition per cent.
Acid, carbonic . . .	1 c. + 2 ox.	22	27 c. + 73 ox.
,, muriatic . . .	1 chl. + 1 h.	37	97 chl. + 3 h.
,, nitric (dry) . .	1 n. + 5 ox.	54	26 n. + 74 ox.
,, do. sp. gr. 1·5 . .	(1· n. + 5 ox.) + 2 w.	72	20· n. + 55· ox. + 25 w.
,, phosphoric . .	1· p. + $2\frac{1}{2}$ ox.	36	44 p. + 56 ox.
,, sulphuric . . .	1· s. + 3 ox.	40	40 s. + 60 ox.
,, do. sp. gr. 1·85 .	(1 s. + 3 ox.) + 1 w.	49	33 s. + 49 ox. + 18 w.
,, uric	5· c. + 2 h. + 3 ox. + 2 n.	84	36· c. + 2 h. + 29 ox. + 33 n.
Alcohol	4 c. + 2 ox. + 6 h.	46	52 c. + 35 ox. + 13 h.
Albumen	40· c. + 31. h. + 12 ox. + 5 n.	437	55 c. + 7 h. + 22 ox. + 16 n.
Alum, anhydrous . .	1· bi. sul. pot. + 2 s. alum.	262	58· b. sul. pot. + 45· s. alum.
,, crystallized . .	(1· b. s. p. + 2. s. a.) + 25 w.	487	30· b. s. p. + 24 su. + 46 w.
,, soda	1· bi. s. sod. + 2· su. alum.	228	49· b. s. s. + 51· s. a.
,, do., crystallized .	(1 b. s. s. + 2 s. a.) + 28 w.	480	23· b. s. s. + 24 s. a. + 53 w.
Alumina	1 aluminum + 1 ox.	18	55 alum. + 45 ox.
,, sulphate . . .	1 al. + 1 s. a.	58	31 al. + 69 s. a.
Aluminum	. .	10	
Ammonia	1· n. + 3 h.	17	82 n. + 18 h.
,, bicarbonate . .	1 am. + 2 c. a.	61	28 am. + 72 c. a.
,, do. crystallized .	(1 am. + 2 c. a.) + 2 w.	79	22 am. + 55 c. a. + 23 w.
,, carbonate . .	1 am. + 1 c. a.	39	44 am. + 56 c. a.
,, muriate . . .	1 am. + 1 m. a.	54	31 am. + 69 m. a.
,, nitrate . . .	1 am. + 1· n. a.	71	24 am. + 76 n. a.
,, do., crystallized .	(1 am. + 1 na.) + 1 w.	80	21 am. + 68 n. a. + 11 w.
,, sesqui carbonat. .	2 am. + 3 c. a.	100	34 am. + 66 c. a.
,, do., crystallized .	(2 am. + 3. c. a.) + 2 w.	118	29 am. + 56 c. a. + 15 w.
,, sulphate . . .	1· am. + 1· s. a.	57	30 am. + 70 s. a.
,, do. crystallized .	(1 am. + 1 s. a.) + 2 w.	75	23 am. + 53· s. a. + 24 w.
Atmospheric air; Mich. Mix.	1 ox. + 2 n.	. .	22 ox. + 78 n.
Azote or nitrogen . .	. .	14	

TABLE II.—*continued.*

Name.	Atomic Composition.	Atomic Weight.	Composition per cent.
Calcium	• •	20	
,, chloride . . .	1· cal. + 1 chl.	56	36 cal. + 64 chl.
Carbon	• •	6	
Casein—animal veg. .	40 c.+31 h.+12 ox.+5 n.	437	55· c.+7 h.+22 ox.+16 n.
Chlorine	• •	36	
Fat—animal (stearine) .	73 c. + 70 h. + 7· ox.	564	78 c. + 12 h. + 10 ox.
,, mutton	?	• •	79 c. + 12 h. + 9 ox.
Fibre, woody	36 c. + 22 h. + 22 ox.	414	52 c. + 5 h. + 43· ox.
Fibrine	40 c.+31 h.+12 ox.+5 n.	437	55· c.+7 h.+22 ox.+16 n.
Gelatine	7 c. + 7 h. + 3 ox. + 1 n.	87 ?	48· c.+8 h.+27 ox.+17 n.
Gluten	40 c.+31 h.+12 ox.+5 n.	437	55 c.+7 h.+22 ox.+16 n.
Gum	13· c. + 12 h. + 12 ox.	186	42 c. + 6 h. + 52 ox.
Hydrogen	• •	1	
Iron	• •	28	
,, protoxide . . .	1· ir. + 1 ox.	36	77 ir. + 23 ox.
,, peroxide . . .	1· ir. + 1½ ox.	40	70 ir. + 30· ox.
,, persulphate . .	1· per. ir. + 1½ s. a.	160	40 per. ir. + 60 s. a.
,, sulphate . . .	1· pro. ir. + 1 s. a.	76	47 pro. ir. + 53· s. a.
,, do., crystallized .	(1· pro. ir. + 1· sa.) + 7 w.	139	26 pro. ir.+29· s. a.+45 w
Lignin	36 c. + 22 h. + 22 ox.	414	52 c. + 5 h. + 43 ox.
Lime	1· calcium + 1 ox.	28	72 cal. + 28· ox.
,, biphosphate . .	1· l. + 2, p. a.	100	28 l. + 72 p. a.
,, carbonate . . .	1· l. + 1· c. a.	50	56 l. + 44 c. a.
,, hydrate . . .	1· l. + 1 water.	37	76 l. + 24 w.
,, muriate . . .	1· l. + 1· m. a.	65	43 l. + 57 m. a.
,, do., crystallized .	(1· l.+ 1 m. a.) + 5 w.	110	25 l. + 34 m. a. + 41· w.
,, phosphate . . .	1· lime + 1· p. a.	64	44 l. + 56 p. a.
,, sulphate . . .	1· l. + 1· s. a.	68	41 l. + 59. s. a.
,, do., crystallized .	(1 l. + 1 s. a.) + 2 w.	86	33 l. + 46 s. a. + 21 w.
Magnesia	1· magnesium + 1 ox.	20	60 mag. + 40 ox.
,, carbonate . .	1 m. + 1. c. a.	42	48 m. + 52 c. a.
,, do., crystallized .	(1 m. + 1· c. a.) + 3 w.	69	29 l. +32 c. a. + 39· w.
,, hydrate . . .	1· m. + 1 w.	29	69 m. + 31· w.
,, muriate . . .	1· m. + 1· m. a.	57	35 m. + 65 m. a.
,, phosphate . .	1· m. + 1· p a.	56	36 m. + 64 p. a.
,, sulphate . . .	1· m. + 1· s. a	60	33 m. + 67 s. a.
,, do., crystallized	(1· m. + 1 s. a.) + 7 w.	123	16 m. + 33 s. a. + 51· w.
Magnesium	• •	12	
,, chloride . . .	1 mag. + 1 chl.	48	42 mag. + 58 chl.
Manganese	• •	28	
,, deutoxide . .	1· man. + 1½ ox.	40	70 man. + 30 ox.
,, protoxide . .	1· man. + 1 ox.	36	77 man. + 23 ox.
,, peroxide . .	1· man. + 2 ox.	44	64 man. + 36 ox.
Nitrogen in azote . .	• •	14	
Oil—animal	?	?	79 c. + 11. h. + 10· ox.
,, vegetable . . .	?	?	76· c. + 11. h. + 13 ox.
Oxygen	• •	8	
Phosphorus	• •	16	
Potash	1· potassium + 1 ox.	48	83 pot. + 17 ox.
,, carbonate . . .	1· p. + 1· c. a.	70	69 p. + 31· c. a.
,, do., crystallized .	(1· p. + 1· c. a.) + 2 w.	88	55 p. + 25 c. a. + 20 w.
,, hydrate . . .	1· p. + 1 w.	57	84 p. + 16 w.
,, muriate	1· p. + 1· m. a.	85	56 p. + 44 m. a.
,, nitrate	1· p. + 1· n. a.	102	47 p. + 53 n. a.
,, phosphate . . .	1· p. + 1· p. a.	84	57 p. + 43 p. a.
,, sulphate . . .	1· p. + 1· s. a.	88	55 p. + 45 s. a.

TABLE II.—*continued.*

Name.	Atomic Composition.	Atomic Weight.	Composition per cent.
Potassium	. .	40	
,, chloride . . .	1· pot. + 1 chl.	76	53 pot. + 47 ox.
Silica, or silicic acid . .	1 silicum + 1 ox.	16	50· sil. + 50. ox.
Silicon	. .	8	
Soda	1· sodium + 1 ox.	32	75· sod. + 25 ox.
,, carbonate . . .	1· s. + 1· c. a.	54	59 s. + 41 c. a.
,, do., crystallized .	(1 s. + 1· c. a.) + 10 w.	144	22· s. + 16· c. a. + 62 w.
,, hydrate	1· s. + 1 w.	41	78 s. + 22 w.
,, muriate . . .	1· s. + 1 m. a.	69	46 s. + 54 m. a.
,, nitrate	1· s. + 1 n. a.	86	37 s. + 63 n. a.
,, sesqui carbonate .	($1\frac{1}{2}$ s. + 1· c. a.) + 2 w.	88	55 s. + 25 c. a. + 20 w.
,, sulphate . . .	1· s. + 1· s. a.	72	44 s. + 56 s. a.
,, do., crystallized .	(1· s. + 1· s. a.) + 10 w.	162	20 s. + 25 s. a. + 55 w.
Sodium	. .	24	
,, chloride . . .	1· sod. + 1 chl.	60	40 sod. + 60 chl.
Starch	36 c. + 30 h. + 30 ox.	486	44 c. + 7 h. + 49 ox.
Sugar	36 c. + 36 h. + 36 ox.	540	40 c. + 7 h. + 53 ox.
Sulphur	. .	16	
Water	1 ox. + 1· h.	9	88 ox. + 12 h.
Wax	?	?	81· c. + 11· h. + 8 ox.

Note.—I believe there is some doubt with respect to the atomic composition of organic compounds. The numbers in the composition per cent. express the *quantity* of each ultimate element contained in 100 parts of the substance, and *not* the number of *atoms*.

Examples to Table Q.—One or two examples will be sufficient to show the method of using this table.

Suppose, for instance, it was required to ascertain the respective amounts of potash and sulphuric acid in 73 lbs. of sulphate of potash.

Now in 88 parts of this salt there are 48 parts of potash and 40 of sulphuric acid (see their respective weights as given in the table); if therefore we multiply 73, the given quantity of the salt, by 40, and divide by 88, it will give the amount of sulphuric acid contained in it, and multiplying by 48, and dividing by 88, the amount of potash—

Thus $73 \times \frac{40}{38} = 33 \cdot 2,$ $\left\{\begin{array}{l}\text{the amount of sulphuric acid contained in the 73 lbs.}\\ \text{of sulphate of potash ;}\end{array}\right.$

and $73 \times \frac{48}{88} = 39 \cdot 8,$ $\left\{\begin{array}{l}\text{the amount of potash contained in the 73 lbs. of sul-}\\ \text{phate of potash.}\end{array}\right.$

73·0. Amount of sulphate of potash.

Or by decimals, by referring to the head, Composition per Cent., of the Table, we find that there are 55 parts of potash and 45 parts of sulphuric acid in 100 parts of sulphate of potash ; if, therefore, we multiply 73, the given quantity of salt, by this

quantity of potash and sulphuric acid, and divide by 100, it will give their respective amounts—

Thus $73 \times \frac{55}{100} = 40 \cdot 15$, $\Big\{$ the amount of potash contained in the 73 lbs. of sulphate of potash;

and $73 \times \frac{45}{100} = 32 \cdot 85$, $\Big\{$ the amount of sulphuric acid contained in the 73 lbs. of sulphate of potash.

73·00. Amount of sulphate of potash given.

In practice, of course, having obtained the amount of one constituent, we should merely subtract it from the total amount of the salt, and thereby obtain the amount of the other at once.

Secondly, suppose it was desired to know how much sulphuric acid of Sp. Gr. 1·85 would be required exactly to neutralize 50 lbs. of lime.

Here, if we multiply the 50 lbs. by 49, the atomic weight of the sulphuric acid, of that specific gravity, and divide by 28, the atomic weight of the lime, we obtain the result 87·5 lbs., as the quantity of sulphuric acid of Sp. Gr. 1·85 required to neutralize that amount of lime; but if it was wished to know how much sulphuric acid would be required to neutralize that quantity, the answer by a similar process would be only 71·4 lbs., for the simple mention of the name of an acid implies that it is in its *dry* state; and, in fact, the total amount of sulphate of lime formed is the same in both cases, the excess in the total amount (16·1) consisting of the *water* that was in combination with the acid, and which, by the application of heat, might be expelled, when the two results would exactly coincide.

TABULATED RESULTS

OF

ANALYSES IN AGRICULTURAL CHEMISTRY.

CONTENTS OF TABLES.

N.B.—Some difficulty has been found in printing these Tables, especially the footnotes, in consequence of the Author's absence in one of the colonies.

A 1.—CORN CROPS.

Class.	Species.	Parts.			General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF Organic or — Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate — Azotized. Authority.	Number of Anal.
Cereals.	Wheat	Grain	–	–	Gregory .	7	–	97·8	2·18	Boussingault	1	47·2	6·0	44·4	2·4	2·90	Gregory .	7
			–	–	Way . . .	62	–	98·1	1·89	– –	–	–	–	–	–	–	Boussingault	1
			–	–	Boussingault	1	–	97·6	2·4	Gilbert . .	12	–	–	–	2·04	2·47	– –	–
		Straw	–	–	Way . . .	40	–	94·9	5·11	Boussingault	1	52·1	5·7	41·8	0·4	0·48	Johnston .	?
			–	–	Boussingault	1	–	93·0	7·0	Boussingault and Payen.	4	–	–	–	0·7	0·85	– –	–
		Chaff .	–	–	Way . . .	40	–	86·0	13·95	Boussingault and Payen.	1	–	–	–	1·1	1·33	– –	–
	Barley	Grain	–	–	Way . . .	3	–	97·5	2·46	Fromberg .	2	–	–	–	1·45	1·75	Proust . .	1
			–	–	Thomson .	1	–	96·9	3·09	Thomson .	1	47·5	6·9	43·6	1·97	2·38	Hermbstadt	1
			–	–	Lawes . .	4	–	97·2	2·77	Lawes . .	4	–	–	–	1·71	2·07	Johnston .	?
		Straw	–	–	Sprengel .	1	–	93·5	6·56	Boussingault and Payen.	1	–	–	–	0·26	0·31	– –	–
			–	–	Fownes .	1	–	93·0	6·97	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	Way . . .	1	–	85·9	14·1	– –	–	–	–	–	–	–	– –	–
	Oats	Grain with husk.	–	–	Way . . .	1	–	97·5	2·54	Boussingault	1	52·6	6·6	37·9	2·93	3·55	Johnston .	?
			–	–	Norton . .	8	–	96·8	3·18	Norton . .	8	–	–	–	3·02	3·65	Norton . .	4
			–	–	Lawes . .	1	–	96·5	3·45	Völcker .	2	–	–	–	2·55	3·09	–	–
		Straw	–	–	Norton . .	6	–	92·1	7·92	Boussingault	1	52·6	5·6	41·4	0·40	0·48	Johnston .	?
			–	–	Boussingault	1	–	94·9	5·10	Völcker .	2	–	–	–	1·42	1·72	– –	–
		Chaff .	–	–	Norton . .	7	–	83·1	16·94	– –	–	–	–	–	–	–	– –	–
	Rye .	Grain	–	–	Way . . .	1	–	98·4	1·60	Boussingault	1	47·5	5·5	45·3	1·73	2·09	Boussingault	1
			–	–	Boussingault	1	–	97·7	2·30	– –	–	–	–	–	–	–	– –	–
			–	–	Herepath .	2	–	97·7	2·28	Herepath .	2	–	–	–	1·85	2·24	– –	–
		Straw	–	–	Way . . .	1	–	96·5	3·48	Boussingault	1	51·6	5·7	42·3	0·40	0·48	– –	–
			–	–	Boussingault	1	–	96·4	3·60	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Leguminous.	Beans	Grain	–	–	– –	–	–	–	–	Way . . .	6	–	–	–	4·00	4·84	Way . . .	5
			–	–	Way . . .	6	–	96·9	3·10	Playfair .	1	46·5	7·1	40·3	6·10	7·38	Boussingault	1
			–	–	Thomson .	1	–	96·0	3·96	Thomson .	1	47·5	–	–	4·80	5·81	Johnston .	?
			–	–	Liebig . .	1	–	96·7	3·29	Lawes . .	4	–	–	–	4·9	5·93	– –	–
		Straw and Pods.	–	–	Way . . .	4	–	94·0	6·01	– –	–	–	–	–	–	–	– –	–
			–	–	Way . . .	1	–	94·4	5·56	– –	–	–	–	–	–	–	– –	–
	Peas .	Grain	–	–	Way . . .	6	–	97·2	2·75	Boussingault	1	47·7	6·2	41·8	4·3	5·20	Boussingault	1
			–	–	Way . . .	2	–	97·5	2·53	Way . . .	6	–	–	–	4·1	4·96	Johnston .	?
			–	–	Boussingault	1	–	96·9	3·10	–	–	–	–	–	–	–	Way . . .	4
		Straw and Pods.	–	–	Way . . .	4	–	92·7	7·30	Boussingault	1	51·7	5·6	40·1	2·6	3·15	– –	–
			–	–	Boussingault	1	–	88·7	11·3	– –	–	–	–	–	–	–	– –	–
	Tares .	Grain	–	–	Sprengel .	1	–	97·0	3·00	Sprengel .	1	–	–	–	4·25	5·14	– –	–
			–	–	Liebig . .	1	–	97·6	2·40	– –	–	–	–	–	–	–	– –	–
		Straw and Pods.	–	–	Sprengel .	1	–	93·5	6·50	Sprengel .	1	–	–	–	1·93	2·34	– –	–
	Lentils	Grain .	–	–	Liebig . .	1	–	97·9	2·06	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. According to Mr. Lawes the market value of wheat does *not* depend upon the percentage of nitrogen.——*b.* Professor to wheat.——*c.* Mr. Norton's analyses show a variation of 6 per cent. in the azotised portion of the organic matter of analyses that have a ? attached to Professor Johnston's name are the mean of the analyses of Dumas, Boussingault, acid is stated at 27·8 and 29·1 respectively—this is manifestly a misprint.

A 1.—CORN CROPS.

EACH PORTION PER CENT.

Combustible Matter.

Elements.

Azotized.			Unazotised.								Inorganic Matter or Ash.												
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
3·5	11·6	–	–	65·5	5·4		14·0	Liebig . .	5	Sorby 3 0·058	1·2	22·4	10·9	2·7	11·2	–	0·8	–	–	–	50·1	0·1	–	
13·5		–	–	73·8	4·7	7·0	1·0	Way . . .	28	–	3·7	31·4	2·7	3·6	12·4	–	0·8	–	–	–	45·0	0·3	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	1·3	29·5	trace	2·9	15·9	–	–	–	trace		47·0	1·0	–	—*a*
	1·6		0·6		36·7		61·1	Way . . .	1	–	63·9	18·0	2·5	7·4	1·9	–	0·5	–	–	–	2·8	3·1	–	
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 3 0·238	67·6	9·2	0·3	8·5	5·0	–	1·0	–	Chl. 0·6		3·1	1·0	–	
–	–	–	–	–	–	–	–	Way . . .	–	Sorby 1 0·091	81·2	9·1	1·8	1·9	1·3	–	0·4	–	–	–	4·3	–	–	
3·0		–	–	87·0	5·0	5·0	?	Way . . .	1	–	30·7	21·1	1·4	1·7	7·3	–	2·1	–	4·3	1·0	28·5	1·9	–	—*b*
6·0		–	0·3	68·7	5·0	5·3	14·7	Liebig . .	2	Sorby 2 0·053	25·6	12·4	8·4	2·5	8·5	–	2·0	–	–	–	39·6	0·1	–	
	13·4		2·8		67·0		16·8	Fresenius .	1	–	28·7	15·4	5·0	3·0	8·0	–	1·0 ?	–	0·4		35·3	3·2	–	
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 2 0·290	73·5	3·4	1·0	10·5	1·5	2·9	0·2	0·4	Chl. 1·3		3·4	2·3	–	
–	–	–	–	–	–	–	–	Fresenius .	1	–	43·8	21·0	0·8	7·2	3·3	–	0·2?	–	8·9		3·1	11·7	–	
–	–	–	–	–	–	–	–	Way . . .	–	–	70·8	7·7	0·4	10·4	1·3	–	1·4	–	–	1·1	2·0	3·0	2·0	
	17·0		6·5		53·0		23·5	Way . . .	1	–	38·5	17·8	3·8	3·5	7·3	–	0·5	–	–	0·9	26·5	1·1	–	—*c*
0·8	1·8	12·8	4·8	49·4	1·7	2·6	26·1	Norton . .	3	Sorby 3 0·081	34·9	12·0	1·7	5·8	5·8	–	1·9	0·5	5·8	0·4	26·0	5·1	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	53·3	12·3	–	3·7	7·7	–	1·3	–	1·0	–	14·9	1·0	–	
	1·6		0·8		42·7		54·9	Norton . .	1	Sorby 3 0·289	35·4	29·0		6·8	2·6	–	0·8	–	–	9·2	–	16·2	–	—*d*
–	–	–	–	–	–	–	–	Liebig . .	1	–	54·3	12·2	13·0	7·3	4·6	–	1·4	–	–	2·5	1·9	2·2	–	
–	–	–	–	–	–	–	–	Way . . .	1	–	59·9	13·1	4·1	8·7	2·6	–	1·4	–	–	1·2	6·3	2·5	0·2	
	10·5		3·5	64·0	11·0	3·0	8·0	Way . . .	1	–	9·2	33·8	0·4	2·6	12·8	–	1·0	–	–	–	39·9	0·2	–	
–	–	–	–	–	–	–	–	Liebig . .	2	Sorby 1 0·051	0·4	22·1	11·6	4·9	10·3	–	1·3	–	–	–	49·5	1·0	–	
–	–	–	–	–	–	–	–	Herepath .	2	–	9·1	13·0	18·0	13·3	11·6	0·2	1·1	–	–	2·8	29·5	1·6	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	64·5	17·2	–	9·1	2·4	–	1·4	–	0·3	0·6	3·8	0·8	–	
–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	1·9	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	32·5		2·4	45·5	5·2	2·4	12·0	Way . . .	6	0·290	0·9	42·1	0·9	8·7	6·6	–	0·4	–	0·3	1·9	31·9	4·5	1·9	
	35·0		2·5		50·0		12·5	Thomson .	1	Sorby 1 0·071	13·1	23·2	9·4	5·2	9·0	–	1·8	–	Chl. 1·7		35·3	1·3	–	—*e*
–	–	–	–	–	–	–	–	Liebig . .	2	–	1·0	30·3	16·2	5·6	8·2	–	1·9	–	–	1·9	33·3	2·4	–	
–	–	–	–	–	–	–	–	Way . . .	4	0·300	3·9	21·3	4·6	21·3	4·9	–	0·9	–	0·9	9·1	7·4	3·2	22·7	
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 0·148	8·0	10·9	9·3	24·9	4·3	–	1·5	–	–	0·3	9·8	1·5	28·4	
	23·3		2·3	53·8	5·7	2·3	12·6	Way . . .	6	0·270	1·2	40·2	0·7	6·3	6·6	–	0·6	–	1·4	0·7	34·8	5·7	1·8	
	28·3		3·3		59·0		9·4	Liebig . .	1	Sorby 1 0·158	0·3	35·2	10·3	2·7	6·9	–	1·9	–	–	2·6	34·0	4·3	–	
–	–	–	1·6	–	–	–	–	Boussingault	1	–	1·5	36·3	1·3	10·4	12·2	–	–	–	–	1·9	31·0	4·8	–	
–	–	–	–	–	–	–	–	Way . . .	4	0·386	5·4	17·2	2·5	38·0	6·7	–	1·8	–	–	3·6	4·5	5·7	14·7	
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 0·214	7·8	8·8	4·9	31·0	5·6	0·3	0·5	–	–	4·6	6·[illegible]	4·9	25·7	
–	–	–	–	–	–	–	–	Sprengel .	1	–	1·0	34·6	9·5	8·3	4·5	–	1·4	–	–	2·0	36·2	2·6	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·0	30·6	9·6	4·8	8·5	–	0·7	–	–	2·0	38·0	4·1	–	
–	–	–	–	–	–	–	–	Sprengel .	1	–	17·6	18·6	1·1	43·3	3·1	–	0·9	–	–	2·1	12·5	1·0	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	1·1	37·8	6·6	5·1	2·0	–	1·6	–	–	6·1	39·[illegible]	–	–	—*f*
–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

Way found that when the extra silica was deducted from the ashes of barley and oats they were very similar in composition different specimens of oats.——*d.* Ash of straw particularly variable both in quantity and composition.——*e.* The proximate and Sprengel, as published by him in his Lectures.——*f.* In Liebig's work the amount of potash and of phosphoric

A 2.—CORN CROPS.

Class.	Species.	Parts.	Proportion per Cent.	Specific Gravity.	General Division. Naturally Dry. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic or Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate. Azotised. Authority.	Number of Anal.
Cereals.	Wheat	Grain	–	–	Gregory .	7	12·9	85·2	1·90	Boussingault	1	40·2	5·1	37·8	2·1	2·54	Gregory .	7
			44	1·38	Way . .	62	11·7	86·6	1·67	– –	–	–	–	–	–	–	Boussingault	1
			43	–	Boussingault	1	14·5	83·5	2·0	Gilbert . .	12	–	–	–	1·70	2·06	– –	–
		Straw	47	–	Way . .	40	12·0	83·5	4·5	Boussingault	1	43·5	4·8	34·9	0·33	0·40	Johnston .	?
			–	–	Boussingault	1	26·0	68·8	5·18	Boussingault and Payen.	4	–	–	–	0·48	0·58	– –	–
		Chaff .	9	–	Way. . .	40	12·2	75·6	12·25	Boussingault and Payen.	1	–	–	–	0·83	0·98	– –	–
	Barley	Grain	–	1·25	Way . .	3	11·0	86·8	2·19	Fromberg .	2	–	–	–	1·26	1·52	Proust . .	1
			–	–	Thomson .	1	13·1	84·2	2·69	Thomson .	1	40·0	5·8	36·7	1·66	2·01	Hermbstadt	1
			–	–	Lawes . .	4	16·3	81·4	2·30	Lawes . .	4	–	–	–	1·39	1·68	Johnston .	?
		Straw	–	–	Sprengel .	1	20·0	74·8	5·25	Boussingault and Payen.	1	–	–	–	0·21	0·25	– –	–
			–	–	Fownes. .	1	15·0?	79·1	5·92	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	Way . .	1	15·0	73·0	12·0	– –	–	–	–	–	–	–	– –	–
	Oats .	Grain (with Husk).	–	1·17	Way . .	1	9·5	88·2	2·30	Boussingault	1	46·3	5·9	33·4	2·58	3·12	Johnston .	?
			–	–	Norton . .	8	12·2	85·0	2·80	Norton . .	8	–	–	–	2·57	3·11	Norton . .	4
			–	–	Lawes . .	1	14·8	82·3	2·94	Völcker .	2	–	–	–	2·10	2·54	– –	–
		Straw	–	–	Norton . .	6	10·4	82·5	7·10	Boussingault	1	43·3	4·6	34·2	0·33	0·40	Johnston .	?
			–	–	Boussingault	1	28·7	67·7	3·60	Völcker .	2	–	–	–	0·96	1·16	– –	–
		Chaff .	–	–	Norton . .	7	11·0	73·9	15·1	– –	–	–	–	–	–	–	– –	–
	Rye .	Grain	40	–	Way. . .	1	15·0	83·6	1·36	Boussingault	1	39·9	4·6	37·8	1·33	1·61	Boussingault	1
			–	–	Boussingault	1	16·6	81·5	1·92	– –	–	–	–	–	–	–	Johnston .	?
			–	–	Herepath .	2	51·0	47·9	1·12	Herepath .	2	–	–	–	0·89	1·08	– –	–
		Straw	–	–	Way . . .	1	10·2	86·7	3·13	Boussingault	1	44·6	5·0	36·7	0·35	0·42	– –	–
			–	–	Boussingault	1	18·7	78·4	2·93	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Leguminous.	Beans	Grain	–	–	– –	–	–	–	–	Way. . .	6	–	–	–	3·13	3·79	Way . .	5
			50	–	Way . .	6	14·6	82·7	2·65	Playfair .	1	38·7	5·8	33·2	5·0	6·05	Boussingault	1
			–	–	Thomson .	1	10·6	86·2	3·22	Thomson .	1	40·8	–	–	4·14	5·01	Johnston .	?
			–	–	Liebig . .	1	15·0	82·2	2·80	Lawes . .	4	–	–	–	4·03	4·88	– –	–
		Straw and Pods.	50	–	Way . .	4	9·9	84·5	5·58	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	10·7	84·3	5·0	– –	–	–	–	–	–	–	– –	–
	Peas .	Grain	44	–	Way . .	6	14·9	82·8	2·34	Boussingault	1	39·3	5·0	34·9	3·6	4·36	Boussingault	1
			–	–	Way . .	2	16·7	81·2	2·10	Way . .	6	–	–	–	3·4	4·11	Johnston .	?
			–	–	Boussingault	1	8·6	88·6	2·83	– –	–	–	–	–	–	–	Way . .	4
		Straw and Pods.	56	–	Way . .	4	9·6	83·8	6·60	Boussingault	1	43·3	4·7	33·6	2·20	2·66	– –	–
			–	–	Boussingault	1	11·8	78·2	10·0	– –	–	–	–	–	–	–	– –	–
	Tares	Grain	–	–	Sprengel .	1	12·5	84·9	2·62	Sprengel .	1	–	–	–	3·61	4·37	– –	–
			–	–	Liebig . .	1	14·5	83·5	2·05	– –	–	–	–	–	–	–	– –	–
		Straw and Pods.	–	–	Sprengel .	1	10·0	84·1	5·85	Sprengel .	1	–	–	–	1·62	1·96	– –	–
	Lentils	Grain .	–	–	Liebig . .	1	13·0	85·2	1·80	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	Boussingault and Payen.	1	–	–	–	1·12	1·36	– –	–

a. Professor Way found that the only loss caused by burning the specimen to be analysed was a portion of the sulphur; conclusion he came to from his numerous analyses of wheat were—1st. That the specific gravity did not always agree composition of the ash of the grain. 3rd. The larger the crop, the smaller the percentage of ash in grain.——*b.* Mr. *quality* of the ash. 2nd. The larger the crop, the *larger* the percentage of ash in grain.——*c.* I have prefixed Liebig's pupils and assistants were not sufficiently well known in England.——*d.* The nitrogen and oil by Professor Way are sulphur, as found by Professor Sorby, not being determined on the same specimen, does not in every case exceed him is not correct for bulky articles.——*f.* The analyses by Sprengel are not deserving of much confidence; in fact,

A 2.—CORN CROPS.

PER CENT.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
3·0	9·9	–	–	55·7	4·6		11·9	Liebig . .	5	Sorby 3 0·05	0·02	0·43	0·21	0·05	0·21	–	0·01	–	–	–	0·95	0·002	–	–*a*
11·7		–	–	63·9	4·1	6·0	0·9	Way . .	28	–	0·66	0·53	0·05	0·06	0·21	–	0·01	–	–	–	0·77	0·005	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	0·03	0·59	trace	0·06	0·32	–	–	–	trace		0·94	0·02	–	
	1·3		0·5		30·7		51·0	Way . .	1	–	2·88	0·81	0·11	0·33	0·09	–	0·02	–	–	–	0·12	0·14	–	
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 2 0·18	3·52	0·48	0·02	0·44	0·26	–	0·05	–	Chl. 0·03		0·16	0·05	–	
–	–	–	–	–	–	–	–	Way . .	1	Sorby 1 0·07	9·99	1·12	0·22	0·23	0·16	–	0·05	–	–	–	0·53	–	–	
2·6		–	–	75·6	4·3	4·3	?	Way . .	1	–	0·69	0·46	0·03	0·04	0·16	–	0·05	–	0·09	0·02	0·63	0·04	–	
5·1		–	0·2	57·8	4·2	4·5	12·4	Liebig . .	2	Sorby 2 0·05	0·69	0·33	0·23	0·07	0·23	–	0·05	–	–	–	1·07	0·003	–	
	10·9		2·3		54·5		13·7	Fresenius .	1	–	0·66	0·35	0·12	0·07	0·19	–	0·02	–	0·009		0·81	0·07	–	
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 2 0·23	5·86	0·18	0·05	0·55	0·08	0·15	0·01	0·02	0·07		0·16	0·12	–	
–	–	–	–	–	–	–	–	Fresenius .	1	–	2·58	1·24	0·05	0·43	0·20	–	0·01	–	0·53		0·18	0·69	...	
–	–	–	–	–	–	–	–	Way . .	1	–	8·49	0·92	0·05	1·25	0·16	–	0·17	–	–	0·13	0·24	0·36	0·24	
	15·0		5·7		46·8		20·7	Way . .	1	–	0·89	0·41	0·09	0·08	0·17	–	0·01	–	–	0·02	0·61	0·03	–	–*b*
0·7	1·4	10·9	4·1	42·0	1·5	2·2	22·3	Norton . .	3	Sorby 3 0·07	0·98	0·34	0·05	0·16	0·16	–	0·05	0·001	0·11	0·001	0·73	0·14	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	1·55	0·36	–	0·11	0·22	–	0·04	–	0·03	–	0·43	0·03	–	
	1·3		0·7		35·2		45·3	Norton . .	1	Sorby 3 0·25	2·52	2·06		0·48	0·18	–	0·06	–	–	0·65	–	1·15	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	1·96	0·44	0·47	0·26	0·17	–	0·05	–	–	0·09	0·07	0·08	–	
–	–	–	–	–	–	–	–	Way . .	1	–	8·95	1·98	0·62	1·31	0·39	–	0·21	–	–	0·18	0·95	0·28	0·03	
8·8		–	2·9	53·5	9·2	2·5	6·7	Way . .	1	–	0·13	0·48	0·006	0·04	0·18	–	0·01	–	–	–	0·57	0·003	–	
–	–	–	–	–	–	–	–	Liebig . .	2	Sorby 1 0·04	0·008	0·42	0·22	0·09	0·20	–	0·02	–	–	–	0·94	0·02	–	–*c*
–	–	–	–	–	–	–	–	Herepath .	2	–	0·10	0·14	0·20	0·15	0·13	0·0003	0·01	–	–	0·03	0·32	0·02	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	1·87	0·50	–	0·27	0·07	–	0·04	–	0·01	0·02	0·11	0·02	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	1·5	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–*d*
	26·9		2·0	37·6	4·3	2·0	9·9	Way . .	6	0·25	0·02	1·11	0·02	0·23	0·18	–	0·01	–	0·008	0·05	0·86	0·12	0·05	
–	30·2	–	2·1		43·1		10·8	Thomson .	1	Sorby 1 0·06	0·42	0·74	0·30	0·17	0·29	–	0·06	–	Chl. 0·05		1·12	0·04	–	
–	–	–	–	–	–	–	–	Liebig . .	2	–	0·03	0·85	0·45	0·16	0·23	–	0·05	–	–	0·05	0·97	0·07	–	
–	–	–	–	–	–	–	–	Way . .	4	0·27	0·22	1·19	0·26	1·19	0·27	–	0·05	–	0·05	0·51	0·41	0·18	1·28	
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 0·13	0·40	0·55	0·47	1·25	0·22	–	0·07	–	–	0·01	0·49	0·07	1·42	
	19·3		1·9	44·6	4·7	1·9	10·4	Way . .	6	0·23	0·03	0·93	0·02	0·14	0·15	–	0·01	–	0·03	0·02	0·81	0·13	0·04	
–	23·0	–	2·7		47·9		7·6	Liebig . .	1	Sorby 1 0·13	0·006	0·74	0·22	0·06	0·14	–	0·04	–	–	0·05	0·71	0·09	–	–*e*
–	–	–	1·3	–	–	–	–	Boussingault	1	–	0·04	1·02	0·04	0·29	0·34	–	–	–	–	0·05	0·87	0·14	–	
–	–	–	–	–	–	–	–	Way . .	4	0·35	0·36	1·14	0·17	2·50	0·44	–	0·12	–	–	0·24	0·30	0·38	0·97	
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 0·19	0·78	0·88	0·49	3·10	0·56	0·03	0·05	–	–	0·46	0·66	0·49	2·57	
–	–	–	–	–	–	–	–	Sprengel .	1	–	0·03	0·90	0·25	0·22	0·12	–	0·04	–	–	0·05	0·94	0·07	–	–*f*
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·04	0·61	0·19	0·10	0·17	–	0·02	–	–	0·04	0·72	0·05	–	
–	–	–	–	–	–	–	–	Sprengel .	1	–	1·03	1·09	0·06	2·53	0·18	–	0·05	–	–	0·12	0·72	0·06	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·02	0·68	0·12	0·09	0·04	–	0·03	–	–	0·11	0·70	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

and therefore *all* those analyses that have not the total amount of sulphur stated are deficient in that respect. The
with the weight per bushel. 2nd. That climate, variety, or soil, had little or no influence on either the quantity or
Norton's results from his investigation of the oat-plant were—1st. That the quality of the soil has influence on the
name to all the analyses done under *his* supervision, although not by himself; as I thought that the names of his
calculated to the amount of organic matter as obtained by him in the general division.—*e*. The total amount of
the amount of sulphuric acid in the specimen analysed, although Professor Way asserts that the method employed by
Liebig asserts that they are totally incorrect. I have never inserted them except when without a choice.

A 3.—CORN CROPS.

Class.	Species.	Parts.	Proportion per Ton.		General Division. Naturally Dry. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Organic or Proximate. Ammonia.	Azotized. Authority.	Number of Anal.
Cereals.	Wheat	Grain	986	–	Gregory .	7	289	1908	43	Boussingault	1	900	114	847	47	57	Gregory .	7
			–	–	Way . . .	62	262	1940	38	– –	–	–	–	–	–	–	Boussingault	1
			–	–	Boussingault	1	325	1870	45	Gilbert . .	12	–	–	–	38	46	– –	–
		Straw	1053	–	Way . . .	40	269	1870	101	Boussingault	1	974	107	782	7	9	Johnston .	?
			–	–	Boussingault	1	582	1541	117	Boussingault and Payen.	4	–	–	–	11	13	– –	–
		Chaff .	201	–	Way . . .	40	273	1693	274	Boussingault and Payen.	1	–	–	–	19	23	– –	–
	Barley	Grain	–	–	Way . . .	3	247	1944	49	Fromberg .	2	–	–	–	28	34	Proust . .	1
			–	–	Thomson .	1	294	1886	60	Thomson .	1	896	130	822	37	45	Hermbstadt	1
			–	–	Lawes . .	4	365	1823	52	Lawes . .	4	–	–	–	31	38	Johnston .	?
		Straw	–	–	Sprengel .	1	448	1675	117	Boussingault and Payen.	1	–	–	–	5	6	– –	–
			–	–	Fownes .	1	336	1772	132	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	Way . . .	1	336	1635	269	– –	–	–	–	–	–	–	– –	–
	Oats .	Grain (with husk).	–	–	Way . . .	1	212	1976	52	Boussingault	1	1037	132	748	58	70	Johnston .	?
			–	–	Norton . .	8	273	1904	63	Norton . .	8	–	–	–	57	69	Norton . .	4
			–	–	Lawes . .	1	332	1842	66	Völcker .	2	–	–	–	47	57	– –	–
		Straw	–	–	Norton . .	6	233	1848	150	Boussingault	1	970	103	766	8	10	Johnston .	?
			–	–	Boussingault	1	643	1516	81	Völcker .	2	–	–	–	22	27	– –	–
		Chaff .	–	–	Norton . .	7	247	1655	338	– –	–	–	–	–	–	–	– –	–
	Rye .	Grain	–	–	Way . . .	1	336	1873	31	Boussingault	1	894	103	847	29	35	Boussingault	1
			–	–	Boussingault	1	372	1825	43	– –	–	–	–	–	–	–	– –	–
			–	–	Herepath .	2	1142	1073	25	Herepath .	2	–	–	–	20	24	– –	–
		Straw	–	–	Way . . .	1	228	1942	70	Boussingault	1	998	112	824	8	10	– –	–
			–	–	Boussingault	1	419	1756	65	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Leguminous.	Beans	Grain	–	–	– –	–	–	–	–	Way . . .	6	–	–	–	70	84	Way . . .	5
			1120	–	Way . . .	6	326	1854	60	Playfair .	1	868	130	744	112	136	Boussingault	1
			–	–	Thomson .	1	237	1931	72	Thomson .	1	914	–	–	93	113	Johnston .	?
			–	–	Liebig . .	1	336	1841	63	Lawes . .	4	–	–	–	90	109	– –	–
		Straw and Pods.	1120	–	Way . . .	4	222	1893	125	– –	–	–	–	–	–	–	– –	–
			–	–	Way . . .	1	240	1888	112	– –	–	–	–	–	–	–	– –	–
	Peas .	Grain	986	–	Way . . .	6	333	1855	51	Boussingault	1	880	112	782	81	98	Boussingault	1
			–	–	Way . . .	2	374	1819	47	Way . . .	6	–	–	–	76	92	Johnston .	?
			–	–	Boussingault	1	193	1984	63	– –	–	–	–	–	–	–	Way . . .	4
		Straw and Pods.	1254	–	Way . . .	4	215	1877	148	Boussingault	1	970	105	753	49	59	– –	–
			–	–	Boussingault	1	264	1752	224	– –	–	–	–	–	–	–	– –	–
	Tares	Grain	–	–	Sprengel .	1	280	1902	58	Sprengel .	1	–	–	–	81	98	– –	–
			–	–	Liebig . .	1	325	1870	45	– –	–	–	–	–	–	–	– –	–
		Straw and Pods.	–	–	Sprengel .	1	224	1885	131	Sprengel .	1	–	–	–	36	44	– –	–
	Lentils	Grain .	–	–	Liebig . .	1	291	1908	40	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. Mr. Lawes found by experiment that he could not increase the nitrogen in grain by the use of nitrogenised manures, but includes the *husk*, but not the *chaff*.—*c.* These specimens must, I think,

A 3.—CORN CROPS.

PER TON, IN POUNDS.

Combustible Matter.											Inorganic Matter or Ash.													
Elements.																								
Azotised.			Unazotised.																					
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
67	222	–	–	1248	103		267	Liebig . .	5	Sorby 3 1·1	0·5	9·6	4·7	1·1	4·7	–	0·2	–	–	–	21·3	0·05	–	–a
262		–	–	1432	92	134	20	Way . .	28	–	1·3	11·8	1·1	1·3	4·5	–	0·2	–	–	–	17·2	0·1	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	0·7	13·2	trace	1·4	7·2	–	–	–	trace		21·1	0·5	–	
	29		11		688		1192	Way . .	1	–	64·5	18·1	2·5	7·4	2·0	–	0·4	–	–	–	2·7	3·1	–	
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 3 4·0	78·8	10·8	0·5	9·9	5·8	–	1·1	–	Chl. 0·7		3·6	1·1	–	
–	–	–	–	–	–	–	–	Way . .	1	Sorby 1 1·6	223·7	25·1	4·9	5·1	3·5	–	1·1	–	–	–	11·8	–	–	
	58		–	1694	96	96	?	Way . .	1	–	15·2	10·3	0·7	0·9	3·6	–	1·1	–	2·0	0·4	14·1	0·9	–	
–	114	–	·4	1295	94	101	278	Liebig . .	2	Sorby 2 1·1	15·5	7·4	5·2	1·6	5·2	–	1·1	–	–	–	24·0	0·07	–	
–	244	–	51		1221		307	Fresenius .	1	–	14·8	7·9	2·7	1·6	4·3	–	0·5	–	0·2		18·2	1·6	–	
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 2 5·2	86·5	4·0	1·1	12·3	1·8	3·4	0·2	0·4	Chl. 1·6		3·6	2·7	–	
–	–	–	–	–	–	–	–	Fresenius .	1	–	57·8	27·8	1·1	9·6	4·5	–	0·2	–	11·9		4·0	15·5	–	
–	–	–	–	–	–	–	–	Way . .	1	–	190·4	20·6	1·1	28·0	3·6	–	3·8	–	–	2·9	5·0	8·1	5·0	
	336		128		1048		464	Way . .	1	–	19·9	9·2	2·0	1·8	3·8	–	0·2	–	–	0·4	13·7	0·7	–	
16	31	244	92	941	33	49	499	Norton . .	3	Sorby 3 1·6	22·0	7·6	1·1	3·6	3·6	–	1·1	0·02	2·4	0·02	15·8	3·1	–	–b
–	–	–	–	–	–	–	–	Boussingault	1	–	34·7	8·1	–	2·5	4·9	–	0·9	–	0·7	–	9·6	0·7	–	
	29		16		788		1015	Norton . .	1	Sorby 3 5·6	56·2	46·1		10·8	4·0	–	1·3	–	–	14·6	–	25·8	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	43·8	9·9	10·5	5·8	3·8	–	1·1	–	–	2·0	1·6	1·8	–	
–	–	–	–	–	–	–	–	Way . .	1	–	200·4	44·4	13·9	29·3	8·7	–	4·7	–	–	4·0	21·3	8·5	0·7	
	197		65	1199	206	56	150	Way . .	1	–	2·9	10·5	0·1	0·9	4·0	–	0·2	–	–	–	12·5	0·1	–	
–	–	–	–	–	–	–	–	Liebig . .	2	Sorby 1 0·9	0·2	9·4	4·9	2·0	4·5	–	0·5	–	–	–	21·1	0·5	–	
–	–	–	–	–	–	–	–	Herepath .	2	–	2·2	3·1	4·5	3·4	2·9	0·007	0·2	–	–	0·7	7·2	0·5	–	·c
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	41·9	11·2	–	6·0	1·6	–	0·9	–	0·2	0·4	2·5	0·5	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	34	–	–	–	–	– – –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	603		45	842	96	45	223	Way . .	6	5·6	0·4	25·3	0·4	5·2	4·0	–	0·2	–	0·2	1·1	19·3	2·7	1·1	
–	677	–	47		965		242	Thomson .	1	Sorby 1 1·4	9·4	16·6	6·7	3·8	6·5	–	1·3	–	Chl. 1·1		25·1	0·9	–	
–	–	–	–	–	–	–	–	Liebig . .	2	–	0·7	19·0	10·1	3·6	5·2	–	1·1	–	–	1·1	21·7	1·6	–	
–	–	–	–	–	–	–	–	Way . .	4	6·0	4·9	26·7	5·8	26·7	6·0	–	1·1	–	1·1	11·4	9·2	4·0	28·3	
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 2·9	9·0	12·3	10·5	28·0	4·9	–	1·6	–	–	0·2	11·0	1·6	31·8	
	432		43	999	105	43	233	Way . .	6	7·2	0·7	20·6	0·4	3·1	3·4	–	0·2	–	0·7	0·4	18·0	2·9	0·9	
–	515	–	61		1073		170	Liebig . .	1	Sorby 1 2·9	0·1	16·6	4·9	1·3	3·1	–	0·9	–	–	1·1	15·9	2·0	–	
–	–	–	29	–	–	–	–	Boussingault	1	–	0·9	22·8	0·9	6·5	7·6	–	–	–	–	1·1	19·5	3·1	–	
–	–	–	–	–	–	–	–	Way . .	4	7·8	8·1	25·5	3·8	56·0	9·9	–	2·7	–	–	5·4	6·7	8·5	21·7	
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 4·5	17·5	19·7	11·0	69·4	12·5	0·7	1·1	–	–	8·1	14·8	11·0	57·6	
–	–	–	–	–	–	–	–	Sprengel .	1	–	0·7	20·1	5·6	4·9	2·7	–	0·9	–	–	1·1	21·0	1·5	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·9	13·7	4·3	2·2	3·8	–	0·5	–	–	0·9	16·1	1·3	–	
–	–	–	–	–	–	–	–	Sprengel .	1	–	23·1	24·4	1·3	56·7	4·0	–	1·1	–	–	2·7	16·1	1·3	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·5	15·2	2·7	2·0	0·9	–	0·7	–	–	2·5	15·7	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

that the whole nitrogen produced in the whole crop did bear a relation to the quantity of manure used.——*b.* This analysis have been cut *very green*, to contain so large a proportion of water.

A 4.—CORN CROPS.

Class.	Species.	Parts.	Proportion per Acre, 200 Weighings.	Number of Bushels and Weight.	General Division. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION PER — Organic or — Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate — Azotised. Authority.	Number of Anal.
Cereals.	Wheat	Grain	–	–	Gregory .	7	257	1698	38	Boussingault	1	798	101	750	42	51	Gregory .	7
			1984	32 at 62	Way . .	62	233	1726	33	– –	–	–	–	–	–	–	Boussingault	1
			–	–	Boussingault	1	287	1653	40	Gilbert . .	12	–	–	–	34	41	– –	–
		Straw .	3360	–	Way . .	40	404	2805	151	Boussingault	1	1461	161	1173	10	12	Johnston .	?
					Boussingault	–	873	2312	175	Boussingault and Payen.	4	–	–	–	16	19	– –	–
		Chaff .	400	–	Way . .	40	49	304	49	Boussingault and Payen.	1	–	–	–	3	4	– –	–
	Barley	Grain	–	–	Way . .	3	279	2205	56	Fromberg .	2	–	–	–	32	39	Proust . .	1
			2544	48 at 53	Thomson .	1	333	2139	69	Thomson .	1	1016	147	932	41	50	Hermbstadt	1
			–	–	Lawes . .	4	414	2068	58	Lawes . .	4	–	–	–	35	42	Johnston .	?
		Straw .	3360	–	Sprengel .	1	672	2512	176	Boussingault and Payen.	1	–	–	–	8	10	– –	–
					Fownes .	1	504	2658	198	– –	–	–	–	–	–	–	– –	–
		Awn .	?	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Oats .	Grain (with husk.)	–	–	Way . .	1	223	2073	54	Boussingault	1	1088	139	785	61	74	Johnston .	?
			2352	56 at 42	Norton .	8	287	1997	66	Norton . .	8	–	–	–	60	73	Norton . .	4
			–	–	Lawes . .	1	348	1934	69	Völcker .	2	–	–	–	49	59	– –	–
		Straw .	4256	–	Norton . .	6	443	3514	302	Boussingault	1	1844	196	1457	14	17	Johnston .	?
					Boussingault	1	1222	2884	153	Völcker .	2	–	–	–	40	48	– –	–
		Chaff .	400	–	Norton . .	7	44	296	60	– –	–	–	–	–	–	–	– –	–
	Rye .	Grain	–	–	Way . .	1	252	1404	23	Boussingault	1	670	77	635	22	27	Boussingault	1
			1680	28 at 60	Boussingault	1	279	13[illegible]9	32	– –	–	–	–	–	–	–	– –	–
			–	–	Herepath .	2	856	805	19	Herepath .	2	–	–	–	15	18	– –	–
		Straw .	3360	–	Way . .	1	342	2913	105	Boussingault	1	1499	168	1233	12	15	– –	–
					Boussingault	1	628	2634	98	– –	–	–	–	–	–	–	– –	–
		Awn .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Leguminous.	Beans	Grain	–	–	– –	–	–	–	–	Way . .	6	–	–	–	65	79	Way . .	5
			–	–	Way . .	6	304	1720	56	Playfair .	1	805	121	690	104	126	Boussingault	1
			2080	32 at 65	Thomson .	1	220	1793	67	Thomson .	1	849	–	–	86	107	Johnston .	?
			–	–	Liebig . .	1	312	1710	58	Lawes . .	4	–	–	–	84	102	– –	–
		Straw and Pods.	2700	–	Way . .	4	267	2282	151	– –	–	–	–	–	–	–	– –	–
					Way . .	1	289	2276	135	– –	–	–	–	–	–	–	– –	–
	Peas .	Grain	–	–	Way . .	6	310	1722	48	Boussingault	1	817	104	726	75	91	Boussingault	1
			2080	32 at 65	Way . .	2	347	1689	44	Way . .	6	–	–	–	71	86	Johnston .	?
			–	–	Boussingault	1	179	1843	58	– –	–	–	–	–	–	–	Way . .	4
		Straw and Pods.	2700	–	Way . .	4	259	2263	178	Boussingault	1	1169	127	907	60	73	– –	–
					Boussingault	1	319	2111	270	– –	–	–	–	–	–	–	– –	–
	Tares .	Grain	–	–	Sprengel .	1	192	1307	40	Sprengel .	1	–	–	–	55	67	– –	–
			1536	24 at 64	Liebig . .	1	223	1286	31	– –	–	–	–	–	–	–	– –	–
		Straw and Pods.	2700	–	Sprengel .	1	270	2271	159	Sprengel .	1	–	–	–	44	53	– –	–
	Lentils	Grain .	–	–	Liebig . .	1	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. The relative proportion of grain to straw in this Table has been calculated from nearly 200 actual weighings of large found by Professor Way, but I think that may be accounted for by his samples being probably selected ones, and not an small samples of Professor Way, but if so, the error is on the right side for all practical purposes.

A 4.—CORN CROPS.

STATUTE ACRE, IN POUNDS.																							
Incombustible Matter.								Inorganic Matter or Ash.															
Elements.																							
Azotised.			Unazotised.																				
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
60	198	–	–	1111	92		238	Liebig . .	5	Sorby 3 1·0	0·4	8·6	4·2	1·0	4·2	–	0·2	–	–	–	19·0	0·04	–
	233	–	–	1274	82	119	18	Way . .	28	–	1·2	10·5	1·0	1·2	4·1	–	0·2	–	–	–	15·3	0·1	–
–	–	–	–	–	–	–	–	Boussingault	1	–	0·6	11·8	trace	1·2	6·4	–	–	–	trace		18·8	0·4	–
	44		17		1031		1713	Way . .	1	–	96·8	27·2	3·7	11·1	3·0	–	0·6	–	–	–	4·0	4·6	–
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 3 6·0	118·3	16·1	0·7	14·8	8·7	–	1·7	–	Chl. 1·0		5·4	1·7	–
–	–	–	–	–	–	–	–	Way . .	1	Sorby 1 0·3	40·3	4·5	0·8	0·9	0·6	–	0·2	–	–	–	2·1	–	–
	66		–	1920	109	109	?	Way . .	1	–	17·5	11·7	0·8	1·0	4·1	–	1·3	–	2·3	0·5	16·0	1·0	–
	130		5	1468	107	114	315	Liebig . .	2	Sorby 2 1·3	17·5	8·4	5·8	1·8	5·8	–	1·3	–	–	–	27·2	0·08	–
	277		59		1384		348	Fresenius .	1	–	16·8	8·9	3·1	1·8	4·8	–	0·5	–	0·2		20·7	1·8	–
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 1 7·8	129·7	6·0	1·6	18·4	2·7	5·1	0·3	0·6	Chl. 2·4		5·4	4·0	–
–	–	–	–	–	–	–	–	Fresenius .	1	–	86·7	41·7	1·6	14·4	6·7	–	0·3	–	17·8		6·0	23·2	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	352		134		1100		487	Way . .	1	–	20·9	9·6	2·1	1·8	4·0	–	0·2	–	–	0·5	14·3	0·7	–
16	33	256	96	987	35	51	524	Norton . .	3	Sorby 3 1·6	23·0	8·0	1·2	3·8	3·8	–	1·2	0·02	2·6	0·02	17·2	3·3	–
–	–	–	–	–	–	–	–	Boussingault	1	–	36·4	8·5	–	2·6	5·2	–	0·9	–	0·7	–	10·1	0·7	–
	55		30		1499		1930	Norton . .	1	Sorby 3 10·6	107·3	87·7		20·3	7·7	–	2·6	–	–	27·7	–	50·0	–
–	–	–	..	–	–	–	–	Liebig . .	1	–	83·5	18·7	20·0	11·1	7·2	–	2·1	–	–	3·8	3·0	3·4	–
–	–	–	–	–	–	–	–	Way . .	1	–	35·8	7·9	2·5	5·2	1·6	–	0·8	–	–	0·7	3·8	1·5	0·1
	148		49	899	154	42	112	Way . .	1	–	2·2	8·1	0·1	0·7	3·0	–	0·2	–	–	–	9·6	0·05	–
–	–	–	–	–	–	–	–	Liebig . .	2	Sorby 1 0·7	0·1	7·1	3·7	1·5	3·4	–	0·3	–	–	–	15·8	0·3	–
–	–	–	–	–	–	–	–	Herepath .	2	–	1·7	2·3	3·4	2·5	2·2	0·005	0·2	–	–	0·5	5·4	0·4	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	62·8	16·8	–	9·1	2·3	–	1·3	–	0·3	0·7	3·7	0·7	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	31	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	559		42	782	89	42	206	Way . .	6	5·2	0·4	23·1	0·4	4·8	3·7	–	0·2	–	0·2	1·0	17·9	2·5	1·0
	628		44		896		225	Thomson .	1	Sorby 1 1·3	8·7	15·4	6·2	3·5	6·0	–	1·2	–	Chl. 1·0		23·3	0·8	–
–	–	–	–	–	–	–	–	Liebig . .	2	–	0·6	17·7	9·4	3·3	4·8	–	1·0	–	–	1·0	20·2	1·5	–
–	–	–	–	–	–	–	–	Way . .	4	7·3	5·9	32·1	7·0	32·1	7·4	–	1·3	–	1·3	13·8	11·1	4·9	34·[illegible]
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 3·5	10·8	14·8	12·7	33·7	5·9	–	1·9	–	–	0·3	13·2	1·9	38·[illegible]
	401		40	928	98	39	216	Way . .	6	4·8	0·6	19·3	0·4	2·9	3·1	–	0·2	–	0·6	0·4	16·8	2·7	0·8
	479		56		996		158	Liebig . .	1	Sorby 1 2·7	0·1	15·4	4·6	1·3	2·9	–	0·9	–	–	1·0	14·8	1·9	–
–	–	–	27	–	–	–	–	Boussingault	1	–	0·8	21·2	0·8	6·0	7·1	–	–	–	–	1·0	18·1	2·9	–
–	–	–	–	–	–	–	–	Way . .	4	9·4	9·7	30·7	4·6	67·5	11·8	–	3·2	–	–	6·4	8·1	10·2	26·1
–	–	–	–	–	–	–	–	Liebig . .	1	Sorby 1 5·1	21·1	23·8	13·2	83·7	15·1	0·8	1·4	–	–	12·4	17·8	13·2	69·4
–	–	–	–	–	–	–	–	Sprengel .	1	–	0·5	13·9	3·8	3·4	1·8	–	0·6	–	–	0·7	14·5	1·1	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·6	9·4	2·9	1·5	2·6	–	0·3	–	–	0·6	11·1	0·8	–
–	–	–	–	–	–	–	–	Sprengel .	1	–	27·8	29·4	1·6	68·3	4·9	–	1·3	–	–	3·2	19·4	1·6	–
–	–	–	–	–	–	–	–	Liebig .	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

quantities of the various crops, grown on different farms with every variety of manure. It is much below the proportion average of the whole field It is very possible, however, that the crops, when weighed, were not in such a dry state as the

B 1.—ROOT CROPS, &c.

Class.	Species.	Parts.			General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF Organic or — Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate — Azotised. Authority.	Number of Anal.
Bulb-producing Plants.	Turnip	Bulbs	–	–	Way . . .	30	–	92·7	7·30	– –	–	–	–	–	–	–	Johnston .	5
Bulb-producing Plants.	Turnip	Bulbs	–	–	Richardson	10	–	91·3	8·73	Richardson	10	45·1	6·1	47·2	1·65	2·00	– –	–
Bulb-producing Plants.	Turnip	Bulbs	–	–	Lawes . .	90	–	92·4	7·56	Lawes . .	18	–	–	–	2·67	3·16	– –	–
Bulb-producing Plants.	Turnip	Bulbs	–	–	Boussingault	1	–	92·4	7·6	Boussingault	1	46·5	5·9	45·8	1·84	2·23	– –	–
Bulb-producing Plants.	Turnip	Tops	–	–	Way . . .	30	–	87·3	12·7	– –	–	–	–	–	–	–	– –	–
Bulb-producing Plants.	Turnip	Tops	–	–	Richardson	10	–	81·8	18·2	Richardson	10	48·5	6·3	42·2	3·0	3·63	– –	–
Bulb-producing Plants.	Turnip	Tops	–	–	Lawes . .	15	–	90·4	9·6	Lawes . .	2	–	–	–	4·31	5·22	– –	–
Bulb-producing Plants.	Turnip	Tops	–	–	McCalmont	1	–	91·3	8·7	– –	–	–	–	–	–	–	– –	–
Bulb-producing Plants.	Mân-gold.	Bulbs	–	–	Way . . .	3	–	90·4	9·57	Fromberg .	3	–	–	–	2·30	2·78	Cameron .	3
Bulb-producing Plants.	Mân-gold.	Bulbs	–	–	Lawes . .	2	–	92·4	7·60	Lawes . .	2	–	–	–	2·10	2·54	– –	–
Bulb-producing Plants.	Mân-gold.	Bulbs	–	–	Boussingault	1	–	93·7	6·30	Boussingault	1	45·7	6·2	46·3	1·8	2·18	– –	–
Bulb-producing Plants.	Mân-gold.	Tops	–	–	Way . . .	3	–	83·0	17·0	Boussingault and Payen.	1	–	–	–	5·4	6·53	– –	–
Bulb-producing Plants.	Mân-gold.	Tops	Withered		Boussingault	1	–	80·2	19·8	Boussingault	1	48·6	6·5	39·2	5·7	6·90	– –	–
Bulb-producing Plants.	Kohl Rabi.	Bulbs	–	–	Horsford .	1	–	92·0	8·0 ?	Horsford .	1	–	–	–	2·17	2·67	Horsford .	1
Bulb-producing Plants.	Kohl Rabi.	Top –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Root Plants.	Carrots	Root	–	–	Way . . .	6	–	93·5	6·50	– –	–	–	–	–	–	–	Hermbstädt	1
Root Plants.	Carrots	Root	–	–	Fromberg .	2	–	90·5	9·49	Horsford .	1	–	–	–	1·34	1·62	Johnston .	?
Root Plants.	Carrots	Top	–	–	Way . . .	3	–	81·3	18·7	Boussingault and Payen.	1	–	–	–	3·61	4·37	– –	–
Root Plants.	Carrots	Top	–	–	Fromberg .	2	–	84·6	15·4	– –	–	–	–	–	–	–	– –	–
Root Plants.	Parsnip	Root –	–	–	Richardson	1	–	93·8	6·18	– –	–	–	–	–	–	–	Crome . .	1
Root Plants.	Parsnip	Top –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Tuber-producing Plants.	Potato	Tuber	–	–	Fromberg, &c.	90	–	96·5	3·5	Fromberg .	7	–	–	–	1·50	1·82	Fromberg .	20
Tuber-producing Plants.	Potato	Tuber	–	–	G. Phillips	1	–	90·6	9·4	Horsford .	2	–	–	–	1·45	1·75	G. Phillips	1
Tuber-producing Plants.	Potato	Tuber	–	–	Boussingault	1	–	96·0	4·0	Boussingault	1	45·9	6·1	46·4	1·60	1·94	– –	–
Tuber-producing Plants.	Potato	Top	–	Stem	Fromberg	7	–	85·1	14·9	Fromberg	?	–	–	–	6·41	7·76	– –	–
Tuber-producing Plants.	Potato	Top	–	Lves.				84·9	15·1									
Tuber-producing Plants.	Potato	Top	–	Straw	Berthier .	1	–	85·0	15·0	Boussingault	1	54·5	6·2	36·6	2·70	3·27	– –	–
Tuber-producing Plants.	Jerusa-lem Ar-tichoke	Tuber	–	–	Way . . .	1	–	88·8	11·2	Boussingault	1	46·0	6·2	46·1	1·70	2·06	Braconnot .	1
Tuber-producing Plants.	Jerusa-lem Ar-tichoke	Tuber	–	–	Boussingault	1	–	94·0	6·0	– –	–	–	–	–	–	–	– –	–
Tuber-producing Plants.	Jerusa-lem Ar-tichoke	Top	–	Stem	Way . .	1	–	95·6	4·4	– –	–	–	–	–	–	–	– –	–
Tuber-producing Plants.	Jerusa-lem Ar-tichoke	Top	–	Lves.				71·7	28·3		–	–	–	–	–	–	– –	–
Tuber-producing Plants.	Jerusa-lem Ar-tichoke	Top	Stlk	withd.	Boussingault	1	–	97·2	2·8	Boussingault	1	47·0	5·6	47·0	0·40	0·48	– –	–
Fruit.	Veget-able marrow	Fruit	–	–	Gyde . .	1	–	94·9	5·1	– –	–	–	–	–	–	–	Gyde . .	1
Fruit.	Veget-able marrow	Stem & leaves	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. Swedes and hybrids.——*b.* Hybrids.——*c.* Norfolk globe.——*d.* Swedes and hybrids.——*e.* Hybrids, large proportion supposed it to be about the same as in the turnip.——*i.* Belgian.——*k.* Evidently calculated without carbonic acid. Red probable that these two specimens were not perfectly freed from dirt.——*o.* Calculated without carbonic acid.——*p.* The large amount of silica might be accounted for by dirt, yet that would not affect the potash. Liebig quotes the silica at from dirt.——*r.* I cannot help thinking that there must be some error in the amount of protein compounds and pectic

B 1.—ROOT CROPS, &c.

EACH PORTION PER CENT.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
3·5	–	–	2·0	–	14·9	58·9	20·3	Way . .	6	Sorby 2 0·446	1·8	34·1	8·0	9·9	2·6	–	0·5	–	–	8·1	9·8	13·1	12·0	-a
–	–	–	–	–	–	–	–	Richardson	10	Sorby 2	3·3	25·1	17·0	11·2	3·6	–	1·3 with Phos. Acid.	–	Chl. 6·1		12·3	12·7	7·4	-b
–	–	–	–	–	–	–	–	Gilbert . .	24	0·386	–	44·8	1·8	11·4	1·5	–	–	–	0·3	6·9	7·9	10·6	14·8	-c
–	–	–	–	–	–	–	–	Boussingault	1	–	8·0	42·0	5·1	13·5	5·3	–	1·5	–	Chl. 3·6		7·5	13·5	?	
–	–	–	–	–	–	–	–	Way . .	6	–	4·0	15·2	2·8	28·5	2·8	–	1·7	–	5·1	15·3	6·2	8·4	10·0	-d
–	–	–	–	–	–	–	–	Richardson	10	Sorby 2	17·4	15·7	6·3	25·6	3·2	–	3·4 with Phos. Acid.	–	Chl. 8·8		3·9	9·9	5·8	-e
–	–	–	–	–	–	–	–	Campbell .	24	0·686	–	22·1	0·2	30·5	0·8	–	–	–	4·8	6·1	5·1	12·6	17·8	-f
–	–	–	–	–	–	–	–	McCalmont	2	–	1·1	14·7	–	22·7	2·8	–	0·6	–	14·6	7·6	8·7	13·7	13·5	-g
0·7	–	2·3	–	–	3·0	73·7	20·3	Way . .	3	Sorby 1 0·058	2·6	24·8	13·8	2·0	2·1	–	0·6	–	–	29·4	3·1	3·3	18·3	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	8·0	39·0	6·0	7·0	4·4	–	2·5	–	Chl. 5·2		6·0	1·6	16·1	
–	–	–	–	–	–	–	–	Way . .	3	Sorby 1 0·502	2·0	21·3	7·0	8·6	8·7	–	1·0	–	–	34·0	5·1	5·8	6·5	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
13·7			–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-h
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
5·5	–	–	1·5	45·0	9·0	39·0	with starch	Way . .	5	–	1·2	32·4	13·5	8·8	4·0	–	1·1	–	–	6·5	8·6	6·6	17·3	-i
13·0			2·5	65·0			19·5	Fromberg .	2	Sorby 1 0·092	1·4	47·6	10·7	7·3	7·2	–	0·3	–	–	9·2	9·4	6·9	?	-k
–	–	–	–	–	–	–	–	Way . .	3	–	4·6	7·1	11·0	32·6	2·9	–	2·4	–	–	13·7	1·7	6·2	17·8	-l
–	–	–	–	–	–	–	–	Fromberg .	2	Sorby 1 0·745	1·6	27·8	–	24·8	6·2	–	0·7	–	4·4	22·1	3·0	9·4	?	-m
10·2	–	–	–	33·5	29·6	26·7	with starch	Sprengel .	1	–	5·4	33·5	4·7	26·8	6·7	0·7	0·7	–	Chl. 7·4		8·7	5·4	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
5·8			1·0	64·2	2·2	13·5	13·3	Fromberg .	4	Sorby 1 0·094	1·7	43·1	3·2	1·7	3·2	–	0·4	–	Chl. 4·7		8·5	15·2	18·3	
–	10·4	–	–	71·0	5·6	3·0	10·0	Fresenius .	1	–	5·1	45·9	–	3·0	7·8	–	0·5?	–	4·9		12·7	6·3	13·8	-n
–	–	–	–	–	–	–	–	Boussingault	1	–	5·6	51·5	trace	1·8	5·4	–	0·5	–	Chl. 2·7		11·3	7·1	13·4	
–	–	–	–	–	–	–	–	Fromberg .	3	Sorby 1 0·389	2·5 3·5	33·6 19·7	3·2 1·5	19·1 26·3	5·1 6·8	– –	1·1 2·9	– –	7·8 9·6	14·8 10·0	6·9 11·2	5·9 8·5	– –	-o
–	–	–	–	–	–	–	–	Fresenius .	1	–	37·4	2·5	1·3	36·1	6·0	–	1·4?	–	2·8		7·2	5·3	?	-p
4·6	–	–	0·4	14·1	5·7	69·5	5·7	Way . .	1	–	1·5	55·9	–	3·3	1·3	–	0·5	–	4·9	–	17·0	3·8	11·8	
–	–	–	–	–	–	–	–	Boussingault	1	–	13·0	44·5	trace	2·3	1·8	–	5·2	–	1·6		10·8	2·2	11·0	-q
–	–	–	–	–	–	–	–	Way . .	1	–	1·5 17·3	38·4 6·8	0·7 3·7	20·3 40·2	1·9 1·9	– –	0·9 1·1	– –	– –	4·7 1·8	3·0 0·6	3·2 2·2	25·4 24·3	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
with Pectic Acid, 43·7			1·8	with fibre.	43·8		10·7	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-r
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

of sand and dirt.—*f*. Norfolk globes.—*g*. White turnip.—*h*. The amount of ash was not stated; I have therefore
and white.—*l*. Probably some dirt adhered to these specimens.—*m*. Carbonic acid not calculated.—*n*. I think it
amount of silica and potash varies in an extraordinary manner from the analysis made by Dr. Fromberg; and though the
the same amount.—*q*. The high amount of silica and oxide of iron is probably caused by the tuber not being perfectly free
acid, particularly as Mr. Gyde says that it is very similar in composition to the turnip.

B 2.—ROOT CROPS, &c.

Class.	Species.	Parts.	Proportion per Cent.	Specific Gravity.	General Division. In Fresh State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic or Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate. Azotized. Authority.	Number of Anal.
Bulb-producing Plants.	Turnips	Bulb	87	0·96	Way . .	30	90·0	9·3	0·73	— —	–	–	–	–	–	–	Johnston .	5
			–	–	Richardson	10	90·0	9·1	0·87	Richardson	10	4·1	0·6	4·3	0·15	0·18	— —	–
			63	0·90	Lawes . .	90	92·2	7·2	0·59	Lawes . .	18	–	–	–	0·19	0·23	— —	–
			–	–	Boussingault	1	91·0	8·3	0·68	Boussingault	1	3·9	0·5	3·8	0·15	0·18	— —	–
		Top .	13	–	Way . .	30	85·5	12·7	1·84	— —	–	–	–	–	–	–	— —	–
			–	–	Richardson	10	87·4	10·3	2·29	Richardson	10	5·0	0·7	4·3	0·31	0·38	— —	–
			37	–	Lawes . .	15	86·7	12·0	1·27	Lawes . .	2	–	–	–	0·52	0·63	— —	–
			–	–	M'Calmont	1	82·4	16·1	1·53	— —	–	–	–	–	–	–	— —	–
	Man-gold.	Bulb .	84	1·02	Way . .	3	90·7	8·4	0·89	Fromberg .	3	–	–	–	0·19	0·23	Cameron .	3
			–	–	Lawes . .	2	85·6	13·3	1·09	Lawes . .	2	–	–	–	0·28	0·34	Herepath .	1
			–	–	Boussingault	1	87·8	11·4	0·77	Boussingault	1	5·2	0·7	5·3	0·21	0·25	— —	–
		Top .	16	–	Way . .	3	90·0	8·3	1·70	Boussingault and Payen.	1	–	–	–	0·45	0·54	— —	–
			–	–	Boussingault	1	88·9	8·9	2·20	Boussingault	1	4·3	0·6	3·5	0·51	0·62	— —	–
	Kohl Rabi.	Bulb .	–	–	Horsford .	1	88·0	11·0	1·0 ?	Horsford .	1	–	–	–	0·24	0·29	Horsford .	1
		Top .	–	–	— —	–	–	–	–	— —	–	–	–	–	–	–	— —	–
Root Plants.	Carrot	Root .	79	–	Way . .	6	86·0	13·1	0·91	— —	–	–	–	–	–	–	Hermbstädt	1
			–	–	Fromberg .	2	80·2	17·9	1·88	Horsford .	1	–	–	–	0·24	0·29	Johnston .	?
		Top .	21	–	Way . .	3	78·0	17·9	4·12	Boussingault and Payen.	1	–	–	–	0·65	0·79	— —	–
			–	–	Fromberg .	2	75·0	21·1	3·86	— —	–	–	–	–	–	–	— —	–
	Parsnip	Root .	–	–	Richardson	1	75·9	22·6	1·49	— —	–	–	–	–	–	–	Crome . .	1
		Top .	–	–	— —	–	–	–	–	— —	–	–	–	–	–	–	— —	–
Tuber-producing Plants.	Potato	Tuber	–	1·10	Fromberg, &c.	90	75·3	23·8	0·87	Fromberg .	7	–	–	–	0·36	0·44	Fromberg .	20
			–	–	G. Phillips	1	75·2	22·5	2·35	Horsford .	2	–	–	–	0·33	0·40	G. Phillips.	1
			–	–	Boussingault	1	75·9	23·1	0·96	Boussingault	1	10·6	1·4	10·7	0·37	0·45	— —	–
		Top .	–	Stem	Fromberg	7	90·2	8·3	1·46	— —	–	–	–	–	–	–	— —	–
				Lves.			83·8	13·8	2·44	Fromberg .	?	–	–	–	0·87	1·05	— —	–
			–	Straw	Berthier .	1	76·0	20·4	3·60	Boussingault	1	11·1	1·3	7·5	0·55	0·67	— —	–
	Jerusa-lem Ar-tichoke	Tuber	–	–	Way . .	1	84·0	14·2	1·79	Boussingault	1	6·5	0·9	6·6	0·24	0·29	Braconnot	1
			–	–	Boussingault	1	80·0	18·8	1·20	— —	–	–	–	–	–	–	— —	–
		Top .	–	Stem	Way . .	1	56·0	42·1	1·94	— —	–	–	–	–	–	–	— —	–
				Lves.			47·0	38·0	15·0	— —	–	–	–	–	–	–	— —	–
			–	Withd	Boussingault	1	12·9	84·7	2·44	Boussingault	1	39·8	4·8	39·8	0·34	0·41	— —	–
Fruit.	Veget-able marrow	Fruit .	–	–	Gyde . .	1	88·2	11·2	0·60	— —	–	–	–	–	–	–	Gyde . .	1
		Stem & leaves	–	–	–	–	–	–	–	— —	–	–	–	–	–	–	— —	–

a. Professor Way found no relation between variety and quantity of ash.—*b.* Professor Way found the leaf more variable vary more than 100 per cent. in some ingredients, but much more constant when calculated for the entire plant.—*d.* White Belgian.—*e.* These amounts are too high, unless the quantity of ash contained in the specimens have been potato very variable.—*h.* Too high, if carbonic acid has not been allowed for in the ash.—*i.* See Note *q*, p. 458.—

B 2.—ROOT CROPS, &c.

PER CENT.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotized.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
0·3	–	–	0·2	–	1·4	5·5	1·9	Way . .	6	Sorby 2 0·05	0·01	0·25	0·06	0·07	0·02	–	0·01	–	–	00·6	00·7	0·09	0·09	–*a*
–	–	–	–	–	–	–	–	Richardson	10	Sorby 2	0·03	0·23	0·15	0·10	0·03	–	0·01	–	Chl. 0·05		0·11	0·11	0·07	
–	–	–	–	–	–	–	–	Gilbert . .	24	0·03	–	0·26	0·01	0·07	0·01	–	with phos. acid.	–	0·002	0·04	0·05	0·06	0·09	
–	–	–	–	–	–	–	–	Boussingault	1	–	0·05	0·29	0·03	0·09	0·04	–	0·01	–	Chl. 0·02		0·05	0·09	?	
–	–	–	–	–	–	–	–	Way . . .	6	–	0·07	0·27	0·05	0·52	0·05	–	0·03	–	0·09	0·27	0·11	0·15	0·19	–*b*
–	–	–	–	–	–	–	–	Richardson	10	Sorby 2	0·40	0·36	0·14	0·59	0·07	–	0·08 with phos. acid.	–	Chl. 0·20		0·09	0·23	0·13	
–	–	–	–	–	–	–	–	Campbell .	24	0·09	–	0·28	0·003	0·39	0·01	–	–	–	0·06	0·08	0·06	0·16	0·23	
–	–	–	–	–	–	–	–	M'Calmont	2	–	0·02	0·22	–	0·35	0·04	–	0·009	–	0·22	0·12	0·13	0·21	0·2[illegible]	
0·1	–	0·2	–	–	0·2	6·2	1·7	Way . .	3	Sorby 1 0·005	0·02	0·22	0·12	0·02	0·02	–	0·01	–	–	0·26	0·03	0·03	0·16	–*c*
0·1	–	–	–	–	2·5	10·7	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	0·06	0·30	0·05	0·05	0·03	–	0·02	–	Chl. 0·04		0·05	0·02	0·12	
–	–	–	–	–	–	–	–	Way . .	3	Sorby 1 0·05	0·03	0·36	0·12	0·15	0·15	–	0·02	–	–	0·58	0·09	0·10	0·11	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	1·5		–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
0·7	–	–	0·2	5·9	1·2	5·1	with starch	Way . .	5	–	0·01	0·29	0·12	0·08	0·04	–	0·01	–	–	0·06	0·08	0·06	0·16	–*d*
	2·3		0·5		11·6		3·5	Fromberg .	2	Sorby 1 0·02	0·03	0·89	0·20	0·14	0·13	–	0·006	–	–	0·17	0·18	0·13	?	–*e*
–	–	–	–	–	–	–	–	Way . .	3	–	0·19	0·29	0·45	1·34	0·12	–	0·10	–	–	0·56	0·07	0·25	0·73	
–	–	–	–	–	–	–	–	Fromberg .	2	Sorby 1 0·16	0·06	1·08	–	0·97	0·24	–	0·03	–	0·17	0·86	0·12	0·37	?	–*f*
2·3	–	–	–	7·6	6·7	6·0	with starch	Sprengel .	1	–	0·08	0·50	0·07	0·40	0·10	0·01	0·01	–	Chl. 0·11		0·13	0·08	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	1·4		0·2	15·2	0·6	3·3	3·1	Fromberg .	4	Sorby 1 0·02	0·01	0·39	0·03	0·01	0·03	–	0·004	–	Chl. 0·04		0·08	0·13	0·16	–*g*
	2·3		–	16·0	1·3	0·7	2·2	Fresenius .	1	–	0·12	1·08	–	0·07	0·18	–	0·01	–	0·11		0·3[illegible]	0·15	0·32	
–	–	–	–	–	–	–	–	Boussingault	1	–	0·05	0·49	trace	0·02	0·05	–	0·005	–	Chl. 0·03		0·11	0·07	0·13	
–	–	–	–	–	–	–	–	Fromberg .	3	Sorby 1 0·08	0·04	0·50	0·05	0·29	0·08	–	0·01	–	0·12	0·22	0·10	0·09	?	–*h*
–	–	–	–	–	–	–	–	– –	–	–	0·09	0·47	0·04	0·63	0·16	–	0·07	–	0·23	0·24	0·27	0·20	?	
–	–	–	–	–	–	–	–	Fresenius .	1	–	1·35	0·09	0·05	1·30	0·21	–	0·05	–	0·10		[illegible]	[illegible]	?	
0·6	–	–	0·1	2·0	0·8	9·9	0·8	Way . .	1	–	0·03	1·01	–	0·06	0·02	–	0·009	–	0·09	–	0·30	0·07	0·2[illegible]	
–	–	–	–	–	–	–	–	Boussingault	1	–	0·16	0·53	trace	0·03	0·02	–	0·06	–	Chl. 0·02		0·13	0·03	0·13	–*i*
–	–	–	–	–	–	–	–	Way . .	1	–	0·03	0·73	0·01	0·39	0·04	–	0·02	–	–	0·09	0·05	0·06	0·48	
–	–	–	–	–	–	–	–	– –	–	–	2·60	1·02	0·56	6·03	0·28	–	0·17	–	–	0·27	0·09	0·33	3·65	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	with pect. acid. 4·9		0·2	with fibre	4·9		1·2	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

than bulb with respect to the quantity of water contained in it; and the composition of the ash of bulb and leaf to *c*. Professor Way found the ash of mangold as variable as the turnip; variety to have no effect upon ash. —— corrected for carbonic acid.——*f*. Too high, for the same reason.——*g*. Dr. Fromberg found the amount of fibre in the *k*. See Note *r*, p. 458. This specimen was three-parts grown.

B 3.—ROOT CROPS, &c.

Class.	Species.	Parts.	Proportion per Ton.	General Division. In Fresh State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Organic or Proximate. Azotised. Authority.	Number of Anal.
Bulb-producing Plants.	Turnip	Bulb	1949	Way . .	30	2016	208	16	— —	–	–	–	–	–	–	Johnston .	5
			–	Richardson	10	2016	204	20	Richardson	10	91·8	13·4	96·3	2·5	3·0	— —	–
			1411	Lawes . .	90	2066	161	13	Lawes . .	18	–	–	–	4·3	5·2	— —	–
			–	Boussingault	1	2038	187	15	Boussingault	1	87·4	11·2	85·1	3·3	4·0	— —	–
		Top	291	Way . . .	30	1915	284	41	— —	–	–	–	–	–	–	— —	–
			–	Richardson	10	1958	231	51	Richardson	10	112·0	15·7	96·3	7·0	8·5	— —	–
			829	Lawes . .	15	1942	269	29	Lawes . .	2	–	–	–	11·6	14·0	— —	–
			–	McCalmont	1	1846	360	34	— —	–	–	–	–	–	–	— —	–
	Mangold.	Bulb .	1882	Way . .	3	2032	188	20	Fromberg .	3	–	–	–	4·3	5·2	Cameron .	3
			–	Lawes . .	2	1917	298	25	Lawes . .	2	–	–	–	6·3	7·6	Herepath .	1
			–	Boussingault	1	1967	255	18	Boussingault	1	116·5	15·7	118·7	4·7	5·7	— —	–
		Top .	358	Way . .	3	2016	186	38	Boussingault and Payen.	1	–	–	–	10·1	12·2	— —	–
			–	Boussingault	1	1992	199	49	Boussingault	1	96·3	13·4	78·4	11·4	13·8	— —	–
	Kohl Rabi	Bulb .	–	Horsford .	1	1971	247	22?	Horsford .	1	–	–	–	5·4	6·5	Horsford .	1
		Top .	–	— —	–	–	–	–	— —	–	–	–	–	–	–	— —	–
Root Plants.	Carrot	Root .	1770	Way . . .	6	1926	294	20	— —	–	–	–	–	–	–	Hermbstädt	1
			–	Fromberg .	2	1797	401	42	Horsford .	1	–	–	–	5·4	6·5	Johnston .	?
		Top .	470	Way . . .	3	1747	401	92	Boussingault and Payen.	1	–	–	–	14·6	17·7	— —	–
			–	Fromberg .	2	1680	473	87	— —	–	–	–	–	–	–	— —	–
	Parsnips.	Root .	–	Richardson	1	1700	506	34	— —	–	–	–	–	–	–	Crome . .	1
		Top .	–	— —	–	–	–	–	— —	–	–	–	–	–	–	— —	–
Tuber-producing Plants.	Potato	Tuber	–	Fromberg, &c.	90	1687	533	20	Fromberg .	7	–	–	–	8·1	9·8	Fromberg .	20
			–	G. Phillips	1	1684	504	52	Horsford .	2	–	–	–	7·4	9·0	G. Phillips .	1
			–	Boussingault	1	1700	518	22	Boussingault	1	237·4	31·4	239·7	8·3	10·0	— —	–
		Top .	Stem	Fromberg.	7	2021	186	33	— —	–	–	–	–	–	–	— —	–
			leaves			1877	309	54	Fromberg .	?	–	–	–	19·5	23·6	— —	–
			Straw	Berthier .	1	1702	457	81	Boussingault	1	248·7	29·1	168·0	12·2	14·8	— —	–
	Jerusalem Artichoke	Tuber	–	Way . . .	1	1882	318	40	Boussingault	1	145·6	20·1	147·8	5·3	6·4	Braconnot .	1
			–	Boussingault	1	1792	421	27	— —	–	–	–	–	–	–	— —	–
		Top .	Stem	Way . .	1	1254	943	43	— —	–	–	–	–	–	–	— —	–
			leaves			1053	851	336	— —	–	–	–	–	–	–	— —	–
			Withd	Boussingault	1	289	1897	54	Boussingault	1	891·0	107·5	891·0	7·6	9·2	— —	–
Fruit.	Vegetable marrow	Fruit .	–	Gyde . .	1	1976	251	13	— —	–	–	–	–	–	–	Gyde . .	1
		Stem & Leaves	–	— —	–	–	–	–	— —	–	–	–	–	–	–	— —	–

a. Swedes and hybrids.——*b.* Hybrids.——*c.* Norfolk globe.——*d.* Swedes and hybrids.——*e.* Hybrids.——*f.* Norfolk globe dirt probably adhered to these specimens ——*l.* Too high by the amount of carbonic acid.——

B 3.—ROOT CROPS, &c.

PER TON, IN POUNDS.																								
Combustible Matter.											Inorganic Matter or Ash.													
Elements.																								
Azotised.			Unazotised.																					
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
6·7	–	–	4·5	–	31·3	123·0	42·5	Way . . .	6	Sorby 2 1·1	0·2	5·6	1·3	1·6	0·4	–	0·2	–	–	1·3	1·6	2·0	2·0	-a
–	–	–	–	–	–	–	–	Richardson.	10	Sorby 2	0·7	5·2	3·4	2·2	0·7	–	0·2 with phos. acid.	–	Chl. 1·1		2·5	2·5	[illegible]	-b
–	–	–	–	–	–	–	–	Gilbert . .	24	0·7	–	5·8	0·2	1·6	0·2	–	–	–	0·04	0·9	1·1	1·3	2·0	-c
–	–	–	–	–	–	–	–	Boussingault	1	–	1·1	6·5	0·7	2·0	0·9	–	0·2	–	Chl. 0·5		1·1	2·0	?	
–	–	–	–	–	–	–	–	Way . .	6	–	1·6	6·1	1·1	11·7	1·1	–	0·7	–	2·0	6·1	2·5	3·4	4·3	-d
–	–	–	–	–	–	–	–	Richardson.	10	Sorby 2	9·0	8·0	3·1	13·2	1·6	–	1·8 with phos. acid.	–	Chl. 4·5		2·0	5·1	2·9	-e
–	–	–	–	–	–	–	–	Campbell .	24	2·0	–	6·3	0·1	8·7	0·2	–	–	–	1·4	1·8	1·4	3·6	5·2	-f
–	–	–	–	–	–	–	–	McCalmont	2	–	0·5	4·9	–	7·8	0·9	–	0·2	–	4·9	2·7	2·9	4·7	4·5	-g
2·2	–	4·5	–	–	4·5	138·9	38·1	Way . . .	3	Sorby 1 0·1	0·4	4·9	2·7	0·4	0·4	–	0·2	–	–	5·8	0·7	0·7	3·6	
2·2	–	–	–	–	56·0	239·8	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	1·3	6·7	1·1	1·1	0·7	–	0·5	–	Chl. 0·9		1·1	0·4	2·7	
–	–	–	–	–	–	–	–	Way . .	3	Sorby 1 1·1	0·6	8·1	2·7	3·4	3·4	–	0·4	–	–	13·0	2·0	2·2	2·5	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
33·6			–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
15·7	–	–	4·5	132·2	26·9	114·2	with starch	Way . . .	5	–	0·2	6·5	2·7	1·8	0·9	–	0·2	–	–	1·3	1·8	1·3	3·6	-h
51·5			11·2		259·9		78·4	Fromberg .	2	Sorby 1 0·5	0·7	19·9	4·5	3·1	2·9	–	0·1	–	–	3·8	4·0	2·9	?	-i
–	–	–	–	–	–	–	–	Way . . .	3	–	4·3	6·5	10·1	30·0	2·7	–	2·2	–	–	12·5	1·6	5·6	16·4	-k
–	–	–	–	–	–	–	–	Fromberg .	2	Sorby 1 3·6	1·3	24·2	–	21·7	5·4	–	0·7	–	3·8	19·3	2·7	8·3	?	-l
51·5	–	–	–	170·2	150·1	134·4	with starch	Sprengel .	1	–	1·8	11·2	1·6	9·0	2·2	0·2	0·2	–	Chl. 2·5		2·9	1·8	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
31·4			4·5	340·5	13·4	73·9	69·4	Fromberg .	4	Sorby 1 0·5	0·2	8·7	0·7	0·2	0·7	–	0·1	–	Chl. 0·9		1·8	2·9	3·6	
	51·5		–	358·4	29·1	15·7	49·3	Fresenius .	1	–	2·7	24·2	–	1·6	4·0	–	0·4	–	2·5		6·7	3·3	[illegible]	
–	–	–	–	–	–	–	–	Boussingault	1	–	1·1	11·0	trace	0·5	1·1	–	0·1	–	Chl. 0·7		[illegible]	[illegible]	[illegible]	
–	–	–	–	–	–	–	–	Fromberg .	3	Sorby 1 1·8	0·9	11·2	1·1	6·5	1·8	–	0·2	–	2·7	4·9	2·2	2·0	?	
–	–	–	–	–	–	–	–	– –	–	–	2·0	10·5	0·9	14·1	3·6	–	1·6	–	5·2	5·4	6·0	4·5	?	
–	–	–	–	–	–	–	–	Fresenius .	1	–	30·2	2·0	1·1	29·1	4·7	–	1·1	–	2·2		5·8	4·3	?	
13·4	–	–	2·2	44·8	17·9	221·8	17·9	Way . . .	1	–	0·7	22·6	–	1·3	0·4	–	0·2	–	2·0	–	6·7	1·6	4·7	
–	–	–	–	–	–	–	–	Boussingault	1	–	3·6	11·9	trace	0·7	0·5	–	1·3	–	Chl. 0·5		2·9	0·7	2·9	
–	–	–	–	–	–	–	–	Way . . .	1	–	0·7	16·4	0·2	8·7	0·9	–	0·5	–	–	2·0	1·1	1·3	10·8	
–	–	–	–	–	–	–	–	– –	–	–	58·2	22·8	12·5	135·1	6·3	–	3·8	–	–	6·0	2·0	7·4	81·8	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
and pec. acid ?	109·8		4·5	with fibre	109·8		26·9	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

——*g*. White turnip,——*h*. Belgian.——*i*. Red and white; too high an amount by the quantity of carbonic acid.——*k*. Some
m. Too high by the amount of carbonic acid.——*n*. Specimens probably not free from dirt.

B 4.—ROOT CROPS, &c.

Class.	Species.	Parts.	Produce per Acre in Tons.	When Pulled.	General Division. In Fresh State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Organic or Proximate. Azotised. Authority.	Number of Anal.
Bulb-producing Plants.	Turnip	Bulb	20	Nov.	Way . .	30	40320	4160	320	– –	–	–	–	–	–	–	Johnston .	5
			30	–	Richardson	10	60480	6120	600	Richardson	10	2754	402	2889	75	91	– –	–
			20	Nov.	Lawes . .	90	41320	3220	260	Lawes . .	18	–	–	–	86	104	– –	–
			20	–	Boussingault	1	40760	3740	300	Boussingault	1	1748	224	1702	66	80	– –	–
		Top	3	–	Way . .	30	5745	852	123	– –	–	–	–	–	–	–	– –	–
			5	–	Richardson	10	9790	1155	255	Richardson	10	560	78	482	35	42	– –	–
			8	–	Lawes . .	15	15536	2152	232	Lawes . .	2	–	–	–	93	112	– –	–
			8	–	McCalmont	1	14768	2880	272	– –	–	–	–	–	–	–	– –	–
	Man-gold.	Bulb	25	Nov.	Way . .	3	50800	4700	500	Fromberg .	3	–	–	–	108	131	Cameron .	3
			–	Apr.	Lawes . .	2	47925	7450	625	Lawes . .	2	–	–	–	158	191	Herepath .	1
			–	–	Boussingault	1	49175	6375	450	Boussingault	1	2905	392	2961	117	142	– –	–
		Top	5	–	Way . .	3	10080	930	190	Boussingault & Payen.	1	–	–	–	51	62	– –	–
			–	–	Boussingault	1	9960	995	245	Boussingault	1	481	67	392	57	69	– –	–
	Kohl Rabi.	Bulb	20	–	Horsford .	1	39420	4940	440?	Horsford .	1	–	–	–	108	130	Horsford .	1
		Top	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Root Plants.	Carrot	Root	15	Nov.	Way . .	6	28890	4410	300	– –	–	–	–	–	–	–	Hermbstädt	1
			15	–	Fromberg .	2	26955	6015	630	Horsford .	1	–	–	–	81	98	Johnston .	?
		Top	4	–	Way . .	3	6988	1604	368	Boussingault & Payen.	1	–	–	–	58	70	– –	–
			4	–	Fromberg .	2	6720	1892	348	– –	–	–	–	–	–	–	– –	–
	Parsnip	Root	15	–	Richardson	1	25500	7590	510	– –	–	–	–	–	–	–	Crome . .	1
		Top –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Tuber-producing Plants.	Potato	Tuber	10	–	Fromberg, &c.	90	16870	5330	200	Fromberg .	7	–	–	–	81	98	Fromberg .	20
			10	–	G. Phillips	1	16840	5040	520	Horsford .	2	–	–	–	74	90	G. Phillips .	1
			10	–	Boussingault	1	17000	5180	220	Boussingault	1	2374	314	2397	83	100	– –	–
		Top –	2	straw	Berthier .	1	3404	914	162	Boussingault	1	497	58	336	24	29	– –	–
	Jerusalem Artichoke	Tuber	10	–	Way . .	1	18820	3180	400	Boussingault	1	1456	201	1478	53	64	Braconnot .	1
			–	–	Boussingault	1	17920	4210	270	– –	–	–	–	–	–	–	– –	–
		Top	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Fruit Plants.	Vegetable marrow	Fruit	20	–	Gyde . .	1	39520	5020	260	– –	–	–	–	–	–	–	Gyde . . .	1
		Stem & Leaves	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. These are the actual mean weights of the 10 crops analysed, grown by 10 different manures.——*b*. Too high by the amount high by the amount of carbonic acid contained.——*e*. The reason of the great difference between the analysis by this large quantity to be an exception to the average amount, I have calculated from it in order to show the immense protein compounds with pectic acid ; it ought rather to be, I think, pectic acid with protein compounds.

B 4.—ROOT CROPS, &c.

PER STATUTE ACRE, IN POUNDS.

Combustible Matter. Elements.								Inorganic Matter or Ash.																
Azotised.			Unazotised.																					
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
134	–	–	90	–	626	2460	850	Way . . .	6	Sorby 2 22	4	112	26	32	8	–	4	–	–	26	32	40	40	
–	–	–	–	–	–	–	–	Richardson	10	Sorby 2	21	156	102	66	21	–	6 with phos. acid.	–	Chl. 33		75	75	48	–a
–	–	–	–	–	–	–	–	Gilbert . .	24	14	–	116	4	32	4	–	–	–	1	18	22	26	40	
–	–	–	–	–	–	–	–	Boussingault	1	–	22	130	14	40	18	–	4	–	Chl. 10		22	40	?	
–	–	–	–	–	–	–	–	Way . . .	6	–	5	18	4	35	3	–	2	–	6	18	8	10	13	
–	–	–	–	–	–	–	–	Richardson	10	Sorby 2	45	40	16	66	8	–	9 with phos. acid	–	Chl. 22		10	25	14	
–	–	–	–	–	–	–	–	Campbell .	24	16	–	50	1	70	2	–	–	–	11	14	11	29	42	
–	–	–	–	–	–	–	–	McCalmont	2	–	4	39	–	62	7	–	2	–	39	22	23	38	36	
55	–	112	–	–	112	3472	952	Way . . .	3	Sorby 1 3	10	123	68	10	10	–	5	–	–	145	18	18	90	
55	–	–	–	–	1400	5995	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Boussingault	1	–	33	168	28	28	18	–	13	–	Chl. 23		28	10	68	
–	–	–	–	–	–	–	–	Way . . .	3	Sorby 1 6	3	40	13	17	17	–	2	–	–	65	10	11	12	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	672		–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
236	–	–	68	1983	404	1713	with starch	Way . . .	5	–	3	97	40	27	13	–	3	–	–	19	27	19	54	
	772		168		3899		1176	Fromberg .	2	Sorby 1 8	10	299	68	47	44	–	1	–	–	57	60	44	?	–b
–	–	–	–	–	–	–	–	Way . . .	3	–	17	26	40	120	11	–	9	–	–	50	6	22	66	–c
–	–	–	–	–	–	–	–	Fromberg .	2	Sorby 1 14	5	97	–	87	21	–	3	–	15	77	11	33	?	–d
772	–	–	–	2550	2252	2016	with starch	Sprengel .	1	–	27	168	24	135	33	3	3	–	Chl. 38		44	27	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	314		45	3405	134	739	694	Fromberg .	4	Sorby 1 5	2	87	7	2	7	–	1	–	Chl. 9		18	29	36	
–	515	–	–	3584	291	157	493	Fresenius .	1	–	27	242	–	16	40	–	4	–	25		67	33	71	–e
–	–	–	–	–	–	–	–	Boussingault	1	–	11	110	–	5	11	–	1	–	Chl. 7		24	16	29	
–	–	–	–	–	–	–	–	Fresenius .	1	–	60	4	2	58	9	–	2	–	4		12	9	?	
134	–	–	22	448	179	2218	179	Way . . .	1	–	7	226	–	13	4	–	2	–	20	–	67	16	47	
–	–	–	–	–	–	–	–	Boussingault	1	–	36	119	trace	7	5	–	13	–	Chl. 5		29	7	29	–f
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	with pec. acid 2196		90	with fibre	2196		538	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–g
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

of carbonic acid contained in the specimen.——*c.* Iron and silica probably increased by some dirt on the leaf.——*d.* Too Fresenius and the others is principally on account of the large proportion of ash stated by Phillips; and although I believe difference caused by a slight increase of ash.——*f.* Specimen probably not free from dirt.—— *g.* Mr. Gyde states it as

C 1.—SOILING AND HAY CROPS.

Class.	Species.	Parts.			General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF EACH — Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Organic or Proximate — Azotised. Authority.	Number of Anal.
Grasses.	Meadow	Soiling	–	–	Boussingault	3	–	93·9	6·10	Boussingault	1	50·3	5·5	42·5	1·65	2·00	Sir H. Davy	2
			–	–	Johnston .	?	–	91·3	8·70	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	–	90·0	10·03	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Boussingault	3	–	93·9	6·10	Boussingault	1	50·3	5·5	42·5	1·65	2·00	Johnston .	?
			–	–	Johnston .	?	–	91·3	8·70	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	–	90·0	10·03	– –	–	–	–	–	–	–	– –	–
	Rye Grass	Soiling	–	–	Way . .	1	–	93·0	6·97	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	–	93·6	6·40	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	–	94·2	5·80	Thomson .	1	49·2	6·4	42·4	1·99	2·41	Sir H. Davy	1
		Hay .	–	–	Way . .	1	–	93·0	6·97	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	–	93·6	6·40	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	–	94·2	5·80	Thomson .	1	49·2	6·4	42·4	1·99	2·41	– –	–
Trefoils.	Red Clover.	Soiling	–	–	Way . .	2	–	92·0	8·00	Boussingault	1	51·3	5·4	41·1	2·2	2·66	Sir H. Davy	2
			–	–	Lawes . .	1	–	92·0	7·99	Lawes . .	1	–	–	–	2·55	3·09	– –	–
			–	–	Liebig	1	–	88·8	11·17	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Way . . .	2	–	92·0	8·00	Boussingault	1	51·3	5·4	41·1	2·2	2·66	Johnston .	?
			–	–	Lawes . .	1	–	92·0	7·99	Lawes . .	1	–	–	–	2·55	3·09	– –	–
			–	–	Liebig . .	1	–	88·8	11·17	– –	–	–	–	–	–	–	– –	–
	White Clover.	Soiling	–	–	Way . .	2	–	91·3	8·72	– –	–	–	–	–	–	–	Sir H. Davy	1
			–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Way . .	2	–	91·3	8·72	– –	–	–	–	–	–	–	– –	–
			–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Leguminous Plants.	Sainfoin	Soiling	–	–	Way . .	1	–	93·7	6·36	– –	–	–	–	–	–	–	Sir H. Davy	1
			–	–	Way . .	1	–	93·5	6·50	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	–	93·3	6·68	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Way . .	1	–	93·7	6·36	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	–	93·5	6·50	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	–	93·3	6·68	– –	–	–	–	–	–	–	– –	–
	Lucerne	Soiling	–	–	Sprengel .	1	–	89·6	10·3	Boussingault	1	–	–	–	1·34	1·62	Sir H. Davy	1
			–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Sprengel .	1	–	89·6	10·3	Boussingault	1	–	–	–	1·34	1·62	– –	–
			–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Vetches .	Soiling	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. Water meadow.——*b.* Italian in flower.——*c.* Italian in seed.——*d.* Perennial.——*e.* I have repeated the analysis of the ——*g.* In seed.——*h.* Clover lucerne.——*i.* I have not been able to find any analysis of

C 1.—SOILING AND HAY CROPS.

PORTION PER CENT.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	20·0		2·6	77·4	Boussingault	3	Sorby 1 0·165	31·5	21·7	1·8	17·9	7·2	–	0·9	–	Chl. 2·6		5·4	2·7	7·3	
–	–	–	–	–	–	–	–	Haidlen .	1	–	60·1	1·2	1·2	10·2	8·6	–	2·6	–	1·3	–	11·5	1·7	0·8	
–	–	–	–	–	–	–	–	Liebig . .	2	–	25·1	19·9	7·8	8·2	2·0	–	1·9	–	4·7	13·1	14·4	3·4	?	
8·7			3·8	50·0			37·5	Boussingault	3	Sorby 1 0·165	31·5	21·7	1·8	17·9	7·2	–	0·9	–	Chl. 2·6		5·4	2·7	7·3	–*a*
–	–	–	–	–	–	–	–	Haidlen .	1	–	60·1	1·2	1·2	10·2	8·6	–	2·6	–	1·3	–	11·5	1·7	0·8	
–	–	–	–	–	–	–	–	Liebig . .	2	–	25·1	19·9	7·8	8·2	2·0	–	1·9	–	4·7	13·1	14·4	3·4	?	
–	–	–	–	–	–	–	–	Way . .	1	0·069	59·2	12·5	4·0	9·9	2·2	–	0·8	–	–	2·3	6·3	2·8	–	
–	–	–	–	–	–	–	–	Way . .	1	0·046	60·6	10·8	0·1	12·3	2·6	–	0·3	–	–	5·6	6·3	1·3	–	
–	–	–	–	11·0		1·7	87·3	Thomson .	1	Sorby 1 0·310	64·6	8·0	2·2	6·5	4·0	–	0·4	–	–	–	12·5	–	–	
–	–	–	–	–	–	–	–	Way . .	1	0·069	59·2	12·5	4·0	9·9	2·2	–	0·8	–	–	2·3	6·3	2·8	–	–*b*
–	–	–	–	–	–	–	–	Way . .	1	0·046	60·6	10·8	0·1	12·3	2·6	–	0·3	–	–	5·6	6·3	1·3	–	–*c*
–	–	–	–	–	–	–	–	Thomson .	1	Sorby 1 0·310	64·6	8·0	2·2	6·5	4·0	–	0·4	–	–	–	12·5	–	–	–*d*
1·3		–	–	13·5		1·7	83·5	Way . .	2	0·470	3·3	14·9	1·4	35·4	11·2	–	1·0	–	3·0	2·4	6·3	4·2	16·9	–*e*
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 2 0·097	5·3	26·6	0·5	24·6	6·3	–	0·3	–	Chl. 2·6		6·3	2·5	25·0	
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·6	16·1	40·7	21·9	8·3	–	0·5	–	–	4·7	4·1	1·1	?	
12·0			4·0	51·7			32·3	Way . .	2	0·470	3·3	14·9	1·4	35·4	11·2	–	1·0	–	3·0	2·4	6·3	4·2	16·9	
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 2 0·097	5·3	26·6	0·5	24·6	6·3	–	0·3	–	Chl. 2·6		6·3	2·5	25·0	
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·6	16·1	40·7	21·9	8·3	–	0·5	–	–	4·7	4·1	1·1	?	
1·3		–	–	12·8		0·4	85·5	Way . .	2	0·380	3·7	14·3	3·7	26·4	8·2	–	2·0	–	–	5·0	11·5	7·2	18·0	
–	–	–	–	–	–	–	–	– –	–	Sorby 2 0·125	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Way . .	2	0·380	3·7	14·3	3·7	26·4	8·2	–	2·0	–	–	5·0	11·5	7·2	18·0	
–	–	–	–	–	–	–	–	– – –	–	Sorby 2 0.125	–	–	–	–	–	–	–	–	–	–	–	–	–	
1·3		–	–	12·0		0·8	85·9	Way . .	1	0·056	3·2	31·9	–	24·3	5·0	–	0·6	–	6·2	0·8	9·4	3·3	15·2	
–	–	–	–	–	–	–	–	Way . .	1	0·068	3·5	29·6	1·2	29·7	4·6	–	0·6	–	–	3·1	8·0	2·3	17·4	
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·8	9·0	10·2	24·9	10·5	–	0·3	–	–	2·4	11·6	1·8	24·3	
–	–	–	–	–	–	–	–	Way . .	1	0·056	3·2	31·9	–	24·3	5·0	–	0·6	–	6·2	0·8	9·4	3·3	15·2	–*f*
–	–	–	–	–	–	–	–	Way . .	1	0·068	3·5	29·6	1·2	29·7	4·6	–	0·6	–	–	3·1	8·0	2·3	17·4	–*g*
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·8	9·0	10·2	24·9	10·5	–	0·3	–	–	2·4	11·6	1·8	24·3	
–	–	–	–	8·0		0·5	91·5	Sprengel .	1	Sorby 3 0·336	3·5	13·9	6·5	50·4	3·5	0·4?	0·4	–	Chl. 3·5		13·5	4·2	?	
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·3	17·3	4·9	28·5	6·7	–	0·4	–	–	2·3	6·6	1·0	29·0	–
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 3 0·336	3·5	13·9	6·5	50·4	3·5	0·4?	0·4	–	Chl. 3·5		13·5	4·2	?	
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·3	17·3	4·9	28·5	6·7	–	0·4	–	–	2·3	6·6	1·0	29·0	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

hay crop under soiling, in order that there might be no misconception concerning the object of this table.——*f*. In flower.
vetch-hay, but only of vetch-straw, which is probably vastly different in its composition.

C 2.—SOILING AND HAY CROPS.

Class.	Species.	Parts.	Proportion per Cent.		General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Organic or Proximate. Azotised. Authority.	Number of Anal.
Grasses.	Meadow	Soiling	–	–	Boussingault	3	75·0	23·5	1·52	Boussingault	1	11·8	1·3	10·0	0·39	0·47	Sir H. Davy	2
			–	–	Johnston .	?	75·0	22·8	2·18	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	75·0	22·5	2·50	– –	–	–	–	–	–	–	– –	–
		Hay	–	–	Boussingault	3	14·0	80·8	5·25	Boussingault	1	40·6	4·5	34·3	1·33	1·61	Johnston .	?
			–	–	Johnston .	?	14·0	78·5	7·50	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	14·0	77·4	8·60	– –	–	–	–	–	–	–	– –	–
	Rye-grass.	Soiling	–	–	Way . .	1	75·0	23·3	1·74	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	75·0	–	–	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	75·0	23·6	1·45	Thomson .	1	11·6	1·5	10·0	0·47	0·53	Sir H. Davy	1
		Hay	–	–	Way . .	1	11·6	82·2	6·16	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	13·1	81·3	5·56	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	15·5	79·5	4·98	Thomson .	1	39·1	5·1	33·7	1·58	1·91	– –	–
Trefoils.	Red Clover.	Soiling	–	–	Way . .	2	75·0	23·0	2·00	Boussingault	1	11·8	1·3	9·4	0·51	0·62	Sir H. Davy	2
			–	–	Lawes . .	1	75·0	23·0	2·00	Lawes . .	1	–	–	–	0·59	0·72	– –	–
			–	–	Liebig . .	1	75·0	22·2	2·79	– –	–	–	–	–	–	–	– –	–
		Hay	–	–	Way . .	2	13·1	80·0	6·95	Boussingault	1	41·0	4·3	32·9	1·76	2·13	Johnston .	?
			–	–	Lawes . .	1	21·4	72·3	6·28	Lawes . .	1	–	–	–	1·84	2·23	– –	–
			–	–	Liebig . .	1	16·0	74·6	9·38	– –	–	–	–	–	–	–	– –	–
	White Clover.	Soiling	–	–	Way . .	2	75·0	22·8	2·18	– –	–	–	–	–	–	–	Sir H. Davy	1
		Hay .	–	–	Way . .	2	12·4	80·0	7·65	– –	–	–	–	–	–	–	– –	–
Leguminous Plants.	Sainfoin	Soiling	–	–	Way . .	1	75·0	23·4	1·59	– –	–	–	–	–	–	–	Sir H. Davy	1
			–	–	Way . .	1	75·0	–	–	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	75·0	23·3	1·67	– –	–	–	–	–	–	–	– –	–
		Hay	–	–	Way . .	1	11·3	83·1	5·65	– –	–	–	–	–	–	–	– –	–
			–	–	Way . .	1	12·3	82·0	5·70	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	14·0	80·3	5·75	– –	–	–	–	–	–	–	– –	–
	Lucerne	Soiling	–	–	Sprengel .	1	75·0	22·4	2·58	Boussingault	1	–	–	–	0·30	0·36	Sir H. Davy	1
		Hay .	–	–	Sprengel .	1	15·0	76·2	8·76	Boussingault	1	–	–	–	1·02	1·23	– –	–
	Vetches	Soiling	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. I have ded: c:d the amount of water in the green st:'e of the various crops from the published reports of 70 practical ; with the mean obtained by Dr. Thomson. Of course it depends upon the age of the plant (or rather maturity);

C 2.—SOILING AND HAY CROPS.

PER CENT.																							
Combustible Matter.								Inorganic Matter or Ash.															
Elements.																							
Azotised.			Unazotised.																				
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	–	–	–	4·7		0·6	18·2	Boussingault	3	Sorby 1 0·04	0·47	0·33	0·03	0·27	0·11	–	0·01	–	Chl. 0·04		0·08	0·04	0·11
–	–	–	–	–	–	–	–	Haidlen .	1	–	1·32	0·03	0·03	0·22	0·19	–	0·06	–	0·03	–	0·25	0·04	0·02
–	–	–	–	–	–	–	–	Liebig . .	2	–	0·63	0·50	0·19	0·20	0·05	–	0·05	–	0·12	0·33	0·36	0·08	?
7·0			3·1	40·4			30·3	Boussingault	3	Sorby 1 0·14	1·64	1·13	0·09	0·93	0·37	–	0·05	–	Chl. 0·13		0·28	0·14	0·38
–	–	–	–	–	–	–	–	Haidlen .	1	–	4·51	0·09	0·09	0·77	0·65	–	0·20	–	0·10	–	0·86	0·13	0·06
–	–	–	–	–	–	–	–	Liebig . .	2	–	2·16	1·71	0·67	0·71	0·16	–	0·16	–	0·4[illegible]	1·13	1·24	0·29	?
–	–	–	–	–	–	–	–	Way . .	1	0·02	1·01	0·21	0·07	0·17	0·04	–	0·01	–	–	0·04	0·11	0·05	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	2·6		0·4	20·6	Thomson .	1	Sorby 1 0·08	0·90	0·11	0·03	0·09	0·06	–	0·01	–	–	–	0·18	–	–
–	–	–	–	–	–	–	–	Way . .	1	0·06	3·67	0·77	0·25	0·61	0·14	–	0·05	–	–	0·14	0·39	0·17	–
–	–	–	–	–	–	–	–	Way . .	1	0·04	3·39	0·60	0·006	0·69	0·15	–	0·02	–	–	0·31	0·35	0·07	–
–	–	–	–	–	–	–	–	Thomson .	1	Sorby 1 0·26	3·23	0·40	0·11	0·32	0·20	–	0·02	–	–	–	0·63	–	–
0·3		–	–	3·1		0·4	19·2	Way . .	2	0·12	0·07	0·30	0·03	0·71	0·22	–	0·02	–	0·06	0·05	0·12	0·08	0·34
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 2 0·02	0·11	0·53	0·01	0·49	0·13	–	0·01	–	Chl. 0·05		0·12	0·05	0·50
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·07	0·45	1·14	0·61	0·23	–	0·01	–	–	0·13	0·11	0·03	?
9·6			3·2	41·4			25·8	Way . .	2	0·41	0·23	1·03	0·10	2·44	0·77	–	0·07	–	0·21	0·17	0·43	0·29	1·17
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 2 0·08	0·33	1·68	0·03	1·55	0·40	–	0·02	–	Chl. 0·16		0·40	0·16	1·58
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·24	1·51	3·82	2·06	0·78	–	0·05	–	–	0·44	0·38	0·10	?
0·3		–	–	2·9		0·1	19·5	Way . .	2	0·09 Sorby 2	0·08	0·31	0·08	0·58	0·18	–	0·04	–	–	0·11	0·25	0·16	0·40
–	–	–	–	–	–	–	–	Way . .	2	0·03 0·33 Sorby 2	0·28	1·09	0·28	2·01	0·62	–	0·15	–	–	0·38	0·87	0·55	1·37
0·3		–	–	2·8		0·2	20·1	Way . .	1	0·01	0·05	0·51	–	0·39	0·08	–	0·01	–	0·10	0·01	0·15	0·05	0·24
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·05	0·15	0·17	0·42	0·18	–	0·005	–	–	0·04	0·20	0·03	0·41
–	–	–	–	–	–	–	–	Way . .	1	0·05	0·18	1·79	–	1·36	0·28	–	0·03	–	0·35	0·04	0·53	0·19	0·85
–	–	–	–	–	–	–	–	Way . .	1	0·06	0·20	1·69	0·07	1·69	0·26	–	0·03	–	–	0·18	0·46	0·13	0·99
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·16	0·52	0·59	1·44	0·61	–	0·02	–	–	0·14	0·67	0·10	1·41
–	–	–	–	1·8		0·1	20·5	Sprengel .	1	Sorby 3 0·08	0·09	0·36	0·17	1·30	0·09	0·01	0·01	–	Chl. 0·09		0·35	0·11	?
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 3 0·29	0·31	1·22	0·57	4·42	0·31	0·04	0·04	–	Chl. 0·31		1·18	0·37	?
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

weighings, on a large scale, and which on an average was found to be 75 per cent., varying from 70 to 80. This agrees
for instance, after-grass would contain a larger proportion of water than the previous cutting, when in its prime.

C 3.—SOILING AND HAY CROPS.

Class.	Species.	Parts.	Proportion per Ton.		General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic or Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate. Azotised. Authority.	Number of Anal.
Grasses.	Meadow	Soiling.	–	–	Boussingault	3	1680	526	34	Boussingault	1	264	29	224	8·7	10·5	Sir H. Davy	2
			–	–	Johnston .	?	1680	511	49	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	1680	504	56	– –	–	–	–	–	–	–	– –	–
		Hay	–	–	Boussingault	3	314	1809	117	Boussingault	1	909	101	768	30·0	36·3	Johnston .	?
			–	–	Johnston .	?	314	1758	168	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	314	1733	193	– –	–	–	–	–	–	–	– –	–
	Rye-grass.	Soiling.	–	–	Way . . .	1	1680	521	39	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	1680	528	32	Thomson .	1	260	34	224	10·5	12·7	Sir H. Davy	1
		Hay	–	–	Way . . .	1	260	1841	139	– –	–	–	–	–	–	–	– –	–
			–	–	Way . . .	1	294	1821	125	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	347	1781	112	Thomson .	1	876	114	755	35·4	42·8	– –	–
Trefoils.	Red Clover.	Soiling.	–	–	Way . . .	2	1680	515	45	Boussingault	1	264	29	211	11·5	13·9	Sir H. Davy	2
			–	–	Lawes . .	1	1680	515	45	Lawes . .	1	–	–	–	13·2	16·0	– –	–
			–	–	Liebig . .	1	1680	497	63	– –	–	–	–	–	–	–	– –	–
		Hay	–	–	Way . . .	2	293	1792	155	Boussingault	1	919	96	737	39·4	47·7	Johnston .	?
			–	–	Lawes . .	1	479	1620	141	Lawes . .	1	–	–	–	40·2	48·6	– –	–
			–	–	Liebig . .	1	358	1671	211	– –	–	–	–	–	–	–	– –	–
	White Clover.	Soiling	–	–	Way . . .	2	1680	511	49	– –	–	–	–	–	–	–	Sir H. Davy	1
		Hay .	–	–	Way . . .	2	278	1792	170	– –	–	–	–	–	–	–	– –	–
Leguminous Plants.	Sainfoin	Soiling.	–	–	Way . . .	1	1680	524	36	– –	–	–	–	–	–	–	Sir H. Davy	1
			–	–	Sprengel .	1	1680	522	38	– –	–	–	–	–	–	–	– –	–
		Hay	–	–	Way . . .	1	253	1861	126	– –	–	–	–	–	–	–	– –	–
			–	–	Way . . .	1	275	1837	128	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	314	1798	128	– –	–	–	–	–	–	–	– –	–
	Lucerne	Soiling	–	–	Sprengel .	1	1680	502	58	Boussingault	1	–	–	–	6·7	8·1	Sir H. Davy	1
		Hay .	–	–	Sprengel .	1	336	1707	197	Boussingault	1	–	–	–	22·9	27·7	– –	–
	Vetches	Soiling	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. I would not advise any confidence to be placed in the proximate analyses of these crops, for in the time of Sir H. Davy
ceding table, are not much to be depended on. I thought it as well, however, to insert them as

C 3.—SOILING AND HAY CROPS.

PER TON, IN POUNDS.																							
Combustible Matter.										Inorganic Matter or Ash.													
Elements.																							
Azotised.			Unazotised.																				
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
—	—	—	—		105·3	13·4	407·3	Boussingault	3	Sorby 1 0·9	10·5	7·4	0·7	6·0	2·5	—	0·2	—	Chl. 0·9		1·8	0·9	2·[illegible] —*a*
—	—	—	—	—	—	—	—	Haidlen .	1	—	29·6	0·7	0·7	4·9	4·3	—	1·3	—	0·7	—	5·6	0·9	6·4
—	—	—	—	—	—	—	—	Liebig . .	2	—	14·1	11·2	4·3	4·5	1·1	—	1·1	—	2·7	7·4	8·1	1·8	?
	156·0		69·0		905·0		678·0	Boussingault	3	Sorby 1 3·1	36·7	25·3	2·0	20·8	8·3	—	1·1	—	Chl. 2·9		6·3	3·1	8·5
—	—	—	—	—	—	—	—	Haidlen .	1	—	101·0	2·0	2·0	17·2	14·6	—	4·5	—	2·2	—	19·3	2·9	1·3
—	—	—	—	—	—	—	—	Liebig . .	2	—	48·4	38·3	15·0	15·9	3·6	—	3·6	—	9·0	25·3	27·8	6·5	?
—	—	—	—	—	—	—	—	Way . . .	1	0·45	22·6	4·7	1·6	3·8	0·9	—	0·2	—	—	0·9	2·5	1·1	—
—	—	—	—		58·0	9·0	461·0	Thomson .	1	Sorby 1 1·8	20·2	2·5	0·7	2·0	1·3	—	0·2	—	—	—	4·0	—	—
—	—	—	—	—	—	—	—	Way . . .	1	1·34	82·2	17·2	5·6	13·7	3·1	—	1·1	—	—	3·1	8·7	3·8	—
—	—	—	—	—	—	—	—	Way. . .	1	0·90	75·9	13·4	0·1	15·5	3·4	—	0·4	—	—	6·9	7·8	1·6	—
—	—	—	—	—	—	—	—	Thomson .	1	Sorby 1 5·8	72·4	9·0	2·5	7·2	4·5	—	0·4	—	—	—	14·1	—	—
6·7		—	—		69·4	9·0	430·0	Way . .	2	2·69	1·6	6·7	0·7	15·9	4·9	—	0·4	—	1·3	1·1	2·7	1·8	7·6
—	—	—	—	—	—	—	—	Boussingault	1	Sorby 2 0·45	2·5	11·9	0·2	11·0	2·9	—	0·2	—	Chl. 1·1		2·7	1·1	11·2
—	—	—	—	—	—	—	—	Liebig . .	1	—	1·6	10·1	25·5	13·7	5·2	—	0·2	—	—	2·9	2·5	0·7	?
	215·0		71·7		927·4		577·9	Way . .	2	9·18	5·2	23·1	2·2	54·7	17·2	—	1·6	—	4·7	3·8	9·6	6·5	26·2
—	—	—	—	—	—	—	—	Boussingault	1	Sorby 2 1·79	7·4	37·6	0·7	34·7	9·0	—	0·4	—	Chl. 3·6		9·0	3·6	35·4
—	—	—	—	—	—	—	—	Liebig . .	1	—	5·4	33·8	85·6	46·1	17·5	—	1·1	—	—	9·9	8·5	2·2	?
6·7		—	—		65·0	2·2	436·8	Way . . .	2	2·02	1·8	6·9	1·8	13·0	4·0	—	0·9	—	—	2·5	5·6	3·6	9·0
—	—	—	—	—	—	—	—	Way . . .	2	7·39	6·3	24·4	6·3	45·0	13·9	—	3·4	—	—	8·5	19·5	12·3	30·7
6·7		—	—		62·7	4·5	450·2	Way . . .	1	0·22	1·1	11·4	—	8·7	1·8	—	0·2	—	2·2	0·2	3·4	1·1	5·4
—	—	—	—	—	—	—	—	Liebig . .	1	—	1·1	3·4	3·8	9·4	4·0	—	0·1	—	—	0·9	4·5	0·7	9·2
—	—	—	—	—	—	—	—	Way . . .	1	1·12	4·0	40·1	—	30·5	6·3	—	0·7	—	7·8	0·9	11·9	4·3	19·0
—	—	—	—	—	—	—	—	Way . . .	1	1·34	4·5	39·8	1·6	39·8	5·8	—	0·7	—	—	4·0	10·3	2·9	22·2
—	—	—	—	—	—	—	—	Liebig . .	1	—	3·6	11·6	13·2	34·3	13·7	—	0·4	—	—	3·1	5·0	2·2	31·6
—	—	—	—		40·2	2·2	459·8	Sprengel .	1	Sorby 3 1·8	2·0	8·1	3·8	29·1	2·0	0·2	0·2	—	Chl. 2·0		7·8	2·5	?
—	—	—	—	—	—	—	—	Sprengel .	1	Sorby 3 6·5	6·9	27·3	12·8	99·0	6·9	0·9	0·9	—	Chl. 6·9		26·4	8·3	?
—	—	—	—	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

this department of chemistry was quite in its infancy, and the remainder of the analyses, for the reason stated in a pre-
showing the present state of chemical knowledge with regard to that question.

C 4.—SOILING AND HAY CROPS.

Class.	Species.	Parts.	Produce per Acre in Tons.	When Cut.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic or Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate. Azotised. Authority.	Number of Anal.
Grasses.	Meadow	Soiling	–	–	Boussingault	3	10920	3419	221	Boussingault	1	1716	189	1456	57	69	Sir H. Davy	2
			6·5	July	Johnston .	?	10920	3321	319	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	10920	3276	364	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Boussingault	3	628	3618	228	Boussingault	1	1818	202	1536	60	73	Johnston .	?
			2·0	July	Johnston .	?	628	3516	336	– –	–	–	–	–	–	–	– –	–
			–	–	Liebig . .	2	628	3466	386	– –	–	–	–	–	–	–	– –	–
	Ryegrass	Soiling	–	–	Way . .	1	10920	3386	254	– –	–	–	–	–	–	–	– –	–
			6·5	July	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	10920	3422	208	Thomson .	1	1690	221	1456	68	82	Sir H. Davy	1
		Hay .	–	–	Way . .	1	520	3682	278	– –	–	–	–	–	–	–	– –	–
			2	July	Way . .	1	588	3642	250	– –	–	–	–	–	–	–	– –	–
			–	–	Thomson .	1	694	3562	224	Thomson .	1	1752	228	1510	71	86	– –	–
Trefoils.	Red Clover.	Soiling	–	–	Way . .	2	10920	3348	292	Boussingault	1	1716	189	1371	74	89	Sir H. Davy	2
			6·5	July	Lawes . .	1	10920	3348	292	Lawes . .	1	–	–	–	76	92	– –	–
			–	–	Liebig . .	1	10920	3230	410	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Way . .	2	586	3584	310	Boussingault	1	1838	192	1474	79	96	Johnston .	?
			2	July	Lawes . .	1	958	3240	282	Lawes . .	1	–	–	–	80	97	– –	–
			–	–	Liebig . .	1	716	3342	422	– –	–	–	–	–	–	–	– –	–
	White Clover.	Soiling	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Leguminous Plants.	Sainfoin	Soiling	–	–	Way . .	1	10920	3406	234	– –	–	–	–	–	–	–	Sir H. Davy	1
			6·5	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	10920	3393	247	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Way . .	1	506	3722	252	– –	–	–	–	–	–	–	– –	–
			2	–	Way . .	1	550	3674	256	– –	–	–	–	–	–	–	– –	–
			–	–	Sprengel .	1	628	3595	256	– –	–	–	–	–	–	–	– –	–
	Lucerne	Soiling	–	–	Sprengel .	1	10920	3263	377	Boussingault	1	–	–	–	44	53	Sir H. Davy	1
			6·5	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	Sprengel .	1	672	3414	394	Boussingault	1	–	–	–	46	56	– –	–
			2	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Vetches	Soiling	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Hay .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. The quantity of ingredients in the soiling and hay crop would be the same per acre, supposing the latter to contain relative amount of ingredient when present only in small proportions ; this arises from only calculating to one decimal, For instance,

Now, supposing these latter numbers to be multiplied by 10, the result would be 1 and 2, or one double the amount of have explained the above in order that a superficial observer might not imagine that it was a *mistake* in the calculation ;

C 4.—SOILING AND HAY CROPS.

PER STATUTE ACRE, IN POUNDS.

Combustible Matter. Elements. Azotised.			Unazotised.					Inorganic Matter or Ash.															
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	–	–	–	6·84		87	2648	Boussingault	3	Sorby 1 6·0	68	48	5	39	16	–	1	–	Chl. 6		12	6	16 —a
–	–	–	–	–	–	–	–	Haidlen .	1	–	192	5	5	32	28	–	8	–	5	–	36	6	3
–	–	–	–	–	–	–	–	Liebig . .	2	–	92	73	28	29	7	–	7	–	18	48	53	12	?
	312		138		1810		1356	Boussingault	3	Sorby 1 6·2	73	51	4	42	17	–	2	–	Chl. 6		12	6	17
–	–	–	–	–	–	–	–	Haidlen .	1	–	202	4	4	34	29	–	9	–	4	–	37	6	3
–	–	–	–	–	–	–	–	Liebig . .	2	–	97	77	30	32	7	–	7	–	18	51	56	13	?
–	–	–	–	–	–	–	–	Way . .	1	2·9	147	31	10	25	6	–	2	–	–	6	16	7	– —b
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	377		59	2996	Thomson .	1	Sorby 1 11·7	131	16	5	13	9	–	2	–	–	–	26	–	–
–	–	–	–	–	–	–	–	Way . .	1	2·7	164	34	11	27	6	–	2	–	–	6	17	8	–
–	–	–	–	–	–	–	–	Way . .	1	1·8	152	27	0·2	31	7	–	1	–	–	14	16	3	–
–	–	–	–	–	–	–	–	Thomson .	1	Sorby 1 11·6	145	18	5	14	9	–	1	–	–	–	28	–	–
44		–	–	451		58	2795	Way . .	2	17·5	10	44	5	103	32	–	3	–	9	7	18	12	49
–	–	–	–	–	–	–	–	Boussingault	1	Sorby 2 3·0	16	77	2	72	19	–	2	–	Chl. 7		18	7	73
–	–	–	–	–	–	–	–	Liebig . .	1	–	10	66	166	89	34	–	2	–	–	19	16	5	?
	43		143		1855		1156	Way . .	2	18·4	10	46	4	110	34	–	3	–	9	7	19	13	52
–		–	–	–	–	–	–	Boussingault	1	Sorby 2 3·6	15	75	2	69	18	–	1	–	Chl. 7		18	7	71
–		–	–	–	–	–	–	Liebig . .	1	–	11	68	172	92	35	–	2	–	–	20	17	5	?
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
44		–	–	408		29	2925	Way . .	1	1·4	7	74	–	57	12	–	2	–	14	2	22	7	35
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	7	22	25	61	26	–	1	–	–	6	29	5	60
–	–	–	–	–	–	–	–	Way . .	1	2·2	8	80	–	61	13	–	2	–	16	2	24	9	[illegible]
–	–	–	–	–	–	–	–	Way . .	1	2·7	9	80	3	80	12	–	2	–	–	8	21	6	44
–	–	–	–	–	–	–	–	Liebig . .	1	–	7	23	26	69	27	–	1	–	–	6	10	4	63
–	–	–	–	262		14	2986	Sprengel .	1	Sorby 3 11·7	13	53	25	189	13	1	1	–	Chl. 13		51	16	?
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 3 13·0	14	55	26	198	14	2	2	–	Chl. 14		53	17	?
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

20 per cent. of water, which new-made hay generally does contain.——*b*. There is also an apparent discrepancy in the he general rule being, that when the following decimal is 5, or above 5, add 1, but when below 5 omit it altogether.
0·14 to one decimal is read 0·1
and 0·16 do. do. 0·2
the other, whereas, had the two decimal places been retained, the result would have been 1 4-10ths and 1 6-10ths. I for as it affects small quantities only, it is not of the slightest practical importance.

D 1.—MISCELLANEOUS CROPS.

Class.	Species.	Parts.			General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF Organic or — Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate — Azotised. Authority.	Number of Anal.
Soiling Crops.	Oat	Whole plant, showing ear.	–	–	Norton	3	–	90·0	10·0	Völcker	2	–	–	–	1·97	2·38	– –	–
	Rye	Whole plant, showing ear.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Cabbage	Rape	–	–	Johnston	?	–	92·0	8·0	Boussingault	1	–	–	–	6·96	8·42	– –	–
		Cabbage	–	–	Johnston	av.	–	86·5	13·5	– –	–	–	–	–	–	–	– –	–
	Mustard	Whole plant, in blossom.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Comfrey	Whole plant, in blossom.	–	–	Sprengel	1	–	80·8	19·1	– –	–	–	–	–	–	–	– –	–
	Furze	Young shoots.	–	–	Furlong & M'Calmont	2	–	93·9	6·1	– –	–	–	–	–	–	–	– –	–
		Whole plant.	–	–	Waldie	1	–	97·4	2·6	– –	–	–	–	–	–	–	Waldie	1
	Tussac Grass.	Leaves	–	–	Johnston	1	–	93·5	6·5	Johnston	4	–	–	–	3·17	3·83	Johnsto	2
		Leaves	–	–	Johnston	1	–	92·2	7·8	– –	–	–	–	–	–	–	– –	–
Seed Crops.	Buck-wheat.	Grain	–	–	Sprengel	1	–	98·4	1·6	Boussingault	1	–	–	–	2·43	2·94	– –	–
		Straw	–	–	– –	–	–	–	–	Boussingault and Payen.	1	–	–	–	0·54	0·65	– –	–
	Canary	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Coriander	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Carraway	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	White Mustard.	Seed	–	–	Liebig	1	–	95·8	4·15	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Brown Mustard.	Seed	–	–	Liebig	1	–	95·7	4·31	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Manufactured Crops.	Hops	Flower	–	–	Way	1	–	91·9	8·1	– –	–	–	–	–	–	–	– –	–
			–	–	Nesbit	2	–	85·5	14·5	– –	–	–	–	–	–	–	– –	–
			–	–	Cameron & M'Calmont	2	–	91·6	8·4	– –	–	–	–	–	–	–	– –	–
		Bine	Stalk		Nesbit	2	–	94·9	5·1	– –	–	–	–	–	–	–	– –	–
			Leaves		Nesbit	2	–	79·1	20·9	– –	–	–	–	–	–	–	– –	–
			Entire		Nesbit	2	–	89·7	10·3	– –	–	–	–	–	–	–	– –	–
	Flax	Stem	–	–	Kane	1	–	95·0	5·0	Kane	1	40·8	7·7	50·9	0·59	0·71	– –	–
			Fibre		Hodges	1	–	99·46	0·54	– –	–	–	–	–	–	–	– –	–
		Seed	–	–	Thomson	1	–	91·9	8·1	Thomson	1	53·9	7·9	33·4	4·80	5·81	Leo Mayer	1
			–	–	Liebig	1	–	95·4	4·63	Lawes	2	–	–	–	4·72	5·71	Johnston	?
			–	–	Lawes	2	–	95·4	4·58	Way	4	–	–	–	5·06	6·12	Way	4
			–	–	Way	4	–	96·1	3·94	– –	–	–	–	–	–	–	– –	–
	Hemp	Stem	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Seed	–	–	Liebig	1	–	94·4	5·60	– –	–	–	–	–	–	–	– –	–
	Chicory	Root	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Tobacco	Leaf	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. This analysis is only an approximation to the truth, being the mean of the analysis of the leaf and straw, as 1
per cent. of the dry substance.——*c*. Grown by the sea-side.——*d*. Grown in a nursery at Edinburgh.——*e*. T
drying of these two samples, which evidently accounts for the increase under sulphuric acid.——*g*. This analysis of
water; but Sproule, on Flax, states it to be of the stem; and in Liebig it is considered to be an analysis of the ste
estimated.

D 1.—MISCELLANEOUS CROPS.

ACH PORTION PER CENT.

ombustible Matter.								Inorganic Matter or Ash.																
lements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analysis.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	Norton .	1	Sorby 1 0·226	46·5	30·3		4·6	1·5	–	0·5	–	–	2·3	4·6	10·4	?	–a
–	–	–	–	–	–	–	–	– –	–	Sorby 1 0·099	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel	1	Sorby 1 0·448	7·6	26·8	8·4	26·4	3·0	0·1	2·2	0·5	Chl. 7·5		6·3	11·2	?	
–	–	–	–	–	–	–	–	Fromberg	1	–	0·7	11·7	20·4	21·0	5·9	–	0·6	–	Chl. 5·8		12·4	21·5	?	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel	1	–	17·2	31·2	10·8	20·7	1·3	0·4	trace	–	Chl. 3·1		11·4	3·9	?	
–	–	–	–	–	–	–	–	Furlong & M'Calmont	2	–	5·6	18·3	7·5	23·4	9·8	–	0·7	–	–	12·2	15·6	6·8	?	
1·4	6·8	–	–	–	6·3	19·1	66·3	Waldie .	1	–	6·0	26·7	0·2	23·4	4·3	–	1·7	–	Chl. 3·8		2·9	11·4	17·6	
20·3			31·9				47·8	Johnston	1	–	3·1	17·3	–	5·5	3·1	–	1·0	–	35·6	12·2	9·6	6·5	6·6	–c
–	–	–	–	–	–	–	–	Johnston	1	–	11·8	19·3	–	11·1	5·0	–	2·5	–	17·3	2·6	10·1	5·8	15·1	–d
–	–	–	–	–	–	–	–	Liebig .	1	–	0·7	8·7	20·1	6·7	10·4	–	1·1	–	–	–	50·1	2·2	?	
–	–	–	–	–	–	–	–	Vauquelin	1	–	17·8	24·5	–	10·8	7·0	11·5	?	–	–	–	–	1·9	26·5	–e
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–	–	–	–	–	–	–	–	Liebig .	1	Way 3 3·00	3·3	9·8	9·2	20·8	11·0	–	1·4	–	–	0·3	36·6	5·3	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig .	3	–	0·9	28·6	7·1	8·3	9·6	–	1·0	–	–	2·1	34·8	5·1	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Way . .	1	0·388	23·0	12·0	–	17·9	5·9	–	1·9	–	5·5	–	21·4	7·0	5·4	
–	–	–	–	–	–	–	–	Nesbit .	2	Sorby 1 0·127	22·9	21·5	–	19·6	5·9	–	3·5	0·8	1·9	5·1	10·9	4·7	3·2	
–	–	–	–	–	–	–	–	Cameron & M'Calmont	2	–	11·1	16·4	6·7	17·9	10·7	–	1·3	–	–	5·3	14·7	15·2	?	–f
–	–	–	–	–	–	–	–	Nesbit .	2	–	5·1	15·8	1·2	23·5	7·9	0·3	0·6	trace	3·7	7·5	7·8	2·9	23·8	
–	–	–	–	–	–	–	–		2	–	15·3	8·8	1·2	36·9	4·1	–	0·9	–	–	6·3	3·7	3·9	18·9	
–	–	–	–	–	–	–	–	Nesbit .	2	Sorby 1 0·091	11·8	11·1	1·2	32·4	5·3	0·1	0·9	trace	1·2	6·7	5·1	3·6	20·5	
–	–	–	–	–	–	–	–	Kane . .	1	–	21·4	9·8	9·8	12·3	7·8	6·1	–	–	Chl. 2·4		10·8	2·7	16·9	–g
–	–	–	–	–	–	–	–	Hodges .	1	–	11·2	–	–	43·6	1·0	–	4·0	–	–	trace	7·7	4·2	28·3	
2·7	2·9	–	11·4	1·5	26·2	10·9	44·4	Thomson	1	–	34·8	16·8	2·2	6·9	8·0	–	3·2	–	trace		25·2	2·9	?	
–	–	15·1	11·3	With fibre.	7·1	10·8	55·7	Liebig .	1	–	0·9	25·9	0·7	26·0	0·2	–	3·7	–	–	1·6	40·1	1·0	?	
–	–	–	40·5	–	–	–	–	Way . .	2	–	1·4	34·2	1·7	8·4	13·1	–	0·5	–	–	0·4	38·5	1·6	0·2	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig .	1	–	14·0	21·7	0·7	26·7	1·0	–	0·8	–	–	0·09	35·0	0·1	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig .	10	–	?	17·4	2·3	41·5	12·2	–	4·4	–	3·1	5·1	2·2	4·0	?	

Norton omitted to give their relative proportions.——*b*. Leaves. Professor Johnston found the ash to vary from 7 to 20 analysis is evidently of little value, and was only inserted for want of a better at the time.——*f*. Sulphur was used in the ash is quoted, in a prize essay of the Royal Agricultural Journal of England, as being that of the residue of flax steep-although there is evidently a mistake in the quantity of potash stated there.——*h*. The amount of silica was probably not

D 2.—MISCELLANEOUS CROPS.

					General Division.					ENTIRE COMPOSITION								
					In Natural State.					Organic or								
										Ultimate Elements.						Proximate		
																Azotised.		
Class.	Species.	Parts.	Proportion per Cent.		Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Authority.	Number of Anal.
Soiling Crops.	Oat	Whole plant, showing ear.	–	–	Norton	3	80·0	18·0	2·01	Völcker	2	–	–	–	0·35	0·42	– –	–
	Rye	Whole plant, showing ear.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Cabbage	Rape	–	–	Johnston	?	90·0	9·2	0·8	Boussingault	1	–	–	–	0·64	0·77	– –	–
		Cabbage	–	–	Johnston	av.	92·0	6·9	1·08	– –	–	–	–	–	–	–	– –	–
	Mustard	Whole plant, in blossom.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Comfrey	Whole plant, in blossom.	–	–	Sprengel	1	88	9·7	2·30	– –	–	–	–	–	–	–	– –	–
	Furze	Young shoots.	–	–	Furlong & M'Calmont	2	77·4	21·2	1·37	– –	–	–	–	–	–	–	– –	–
		Whole plant.	–	–	Waldie	1	16·2	81·6	2·18	– –	–	–	–	–	–	–	Waldie	1
	Tussac Grass.	Leaves	–	–	Johnston	1	80·7	18·0	1·25	Johnston	4	–	–	–	0·57	0·69	Johnston	2
		Leaves	–	–	Johnston	1	80·0	18·4	1·56	– –	–	–	–	–	–	–	– –	–
Seed Crops.	Buck-wheat.	Grain	–	–	Sprengel	1	14·0	84·6	1·38	Boussingault	1	–	–	–	2·06	2·49	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Canary	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Coriander	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Carraway	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	White Mustard.	Seed	–	–	Liebig	1	10·0?	86·2	3·78	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Brown Mustard.	Seed	–	–	Liebig	1	10·0?	86·1	3·87	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Manufactured Crops.	Hops	Flower	–	–	Way	1	9·9	82·8	7·27	– –	–	–	–	–	–	–	– –	–
			As 53	sold	Nesbit	2	12·9	74·5	12·6	– –	–	–	–	–	–	–	– –	–
			–	–	Cameron & M'Calmont	2	4·5	87·5	7·98	– –	–	–	–	–	–	–	– –	–
		Bine	33	Stalk	Nesbit	2	9·4	86·0	4·61	– –	–	–	–	–	–	–	– –	–
			14	Leaves		2	11·0	70·4	18·6	– –	–	–	–	–	–	–	– –	–
			47	Entire	Nesbit	2	9·9	80·8	9·3	– –	–	–	–	–	–	–	– –	–
	Flax	Stem	100	Straw	Kane	1	14·0?	81·7	4·30	Kane	1	33·3	6·3	41·6	0·48	0·58	– –	–
			17	Fibre	Hodges	1	10·0?	89·5	0·49	– –	–	–	–	–	–	–	– –	–
		Seed	–	–	Thomson	1	14·2	78·9	6·94	Thomson	1	42·5	6·2	26·4	3·79	4·59	Leo Mayer	1
			–	–	Liebig	1	14·0	82·0	3·96	Lawes	2	–	–	–	3·87	4·68	Johnston	?
			–	–	Lawes	2	9·0	86·8	4·18	Way	4	–	–	–	4·35	5·26	Way	4
			–	–	Way	4	10·6	[illegible]5·9	3·52	– –	–	–	–	–	–	–	– –	–
	Hemp	Stem	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Seed	–	–	Liebig	1	14·0	81·2	4·82	– –	–	–	–	–	–	–	– –	–
	Chicory	Root	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Tobacco	Leaf	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. See Note *a*, p. 474.——*b.* Leaves.——*c.* Probably dried in the air.——*d.* Grown by sea-side.——*e.* Grown in a nursery. See Note *g*, p. 474.——*i.* The proximate analyses of these two have evidently been made after the oil has been being stated to be analyses of linseed.

D 2.—MISCELLANEOUS CROPS.

PER CENT.

Combustible Matter. Elements. Azotised. Albumen.	Gluten.	Casein.	Unazotised. Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Inorganic Matter or Ash. Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	Norton .	1	Sorby 1 0·05	0·93	0·61		0·09	0·03	–	0·01	–	–	0·05	0·09	0·21	?	–*a*
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel	1	Sorby 1 0·05	0·06	0·22	0·07	0·21	0·02	0·0008	0·02	0·004	Chl. 0·06		0·05	0·09	?	
–	–	–	–	–	–	–	–	Fromberg	1	–	0·008	0·13	0·22	0·23	0·06	–	0·007	–	Chl. 0·06		0·13	0·23	?	–*b*
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel	1	–	0·40	0·72	0·25	0·48	0·03	0·009	trace	–	Chl. 0·07		0·26	0·09	?	
–	–	–	–	–	–	–	–	Furlong & M'Calmont	2	–	0·08	0·26	0·10	0·33	0·14	–	0·01	–	–	0·17	0·22	0·09	?	
1·1	5·6	–	–	–	5·2	15·6	54·1	Waldie .	1	–	0·13	0·59	0·005	0·51	0·09	–	0·04	–	Chl. 0·08		0·06	0·25	0·39	–*e*
	3·7			5·7			8·6	Johnston	1	–	0·04	0·22	–	0·07	0·04	–	0·01	–	0·46	0·16	0·12	0·08	0·08	–*d*
–	–	–	–	–	–	–	–	Johnston	1	–	0·19	0·30	–	0·17	0·08	–	0·04	–	0·27	0·08	0·16	0·09	0·25	–*c*
–	–	–	–	–	–	–	–	Liebig .	1	–	0·01	0·12	0·28	0·09	0·15	–	0·02	–	–	–	0·70	0·03	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–	–	–	–	–	–	–	–	Liebig .	1	Way 3 2·70	0·12	0·37	0·35	0·79	0·42	–	0·05	–	–	0·01	1·39	0·20	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig .	3	–	0·03	1·12	0·28	0·32	0·37	–	0·04	–	–	0·08	[illegible]	0·20	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Way . .	1	0·35	1·68	0·88	–	1·31	0·43	–	0·14	–	0·40	–	1·56	0·51	0·39	
–	–	–	–	–	–	–	–	Nesbit .	2	Sorby 1 0·10	2·89	2·71	–	2·47	0·74	–	0·44	0·10	0·24	0·64	1·37	0·59	0·40	
–	–	–	–	–	–	–	–	Cameron & M'Calmont	2	–	0·89	1·31	0·54	1·43	0·86	–	0·10	–	–	0·42	1·18	1·22	?	–*f*
–	–	–	–	–	–	–	–	Nesbit .	2	–	0·23	0·73	0·06	1·08	0·36	0·01	0·03	trace	0·17	0·35	0·36	0·13	1·09	–*g*
–	–	–	–	–	–	–	–		2	–	2·85	1·64	0·22	6·8[illegible]	0·76	–	0·17	–	–	1·17	0·69	0·73	[illegible]	
–	–	–	–	–	–	–	–	Nesbit .	2	Sorby 1 0·08	1·10	1·03	0·11	3·0[illegible]	0·49	0·01	0·08	trace	0·11	0·62	[illegible]	[illegible]	[illegible]	
–	–	–	–	–	–	–	–	Kane . .	1	–	0·92	0·42	0·42	0·53	0·34	0·26	–	...	Chl. 0·19		[illegible]	1·12	0·73	–*h*
–	–	–	–	–	–	–	–	Hodges .	1	–	0·03	–	–	0·22	0·005	–	0·02	–	–	trace	0·04	0·02	0·14	
2·1	2·3	–	9·0	1·2	20·7	8·6	35·0	Thomson	1	–	2·49	1·16	0·15	0·48	0·55	–	0·22	–	trace		1·74	0·20	?	–*i*
–	–	12·4	9·3	with fibre.	5·8	8·8	45·7	Liebig .	1	–	0·03	1·03	0·03	1·04	0·01	–	0·15	–	–	[illegible]	[illegible]	[illegible]	?	
–	–	–	34·8	–	–	–	–	Way . .	2	–	0·05	1·20	0·06	0·30	0·46	–	0·02	–	–	0·01	1·36	0·06	0·007	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig .	1	–	0·67	1·04	0·03	1·29	0·05	–	0·04	–	–	0·04	[illegible]	[illegible]	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

——*f*. Sulphur used in the drying of these two specimens, but not in the preceding.——*g*. Dried in the air.——*h*. Harvested. expressed. Compare them with the analyses of oil-cake given hereafter. I inserted them in this place on account of their

D 3.—MISCELLANEOUS CROPS.

Class.	Species.	Parts.	Proportion per Ton.		General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Ultimate Elements. Authority.	No. of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Organic or Proximate. Azotized. Authority.	Number of Anal.
Soiling Crops.	Oat	Whole Plant showing ear.	–	–	Norton	3	1792	403	45	Völcker	2	–	–	–	7·9	9·5	– –	–
	Rye	Whole Plant showing ear.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Cabbage	Rape	–	–	Johnston	1	2016	206	18	Boussingault	1	–	–	–	14·3	17·3	– –	–
		Cabbage	–	–	Johnston	av.	2061	155	24	– –	–	–	–	–	–	–	– –	–
	Mustard	Whole Plant in blossom.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Comfrey	Whole Plant in blossom.	–	–	Sprengel	1	1971	217	52	– –	–	–	–	–	–	–	– –	–
	Furze	Young shoots.	–	–	Furlong & M'Calmont	2	1734	475	31	– –	–	–	–	–	–	–	– –	–
		– –	–	–	Waldie	1	363	1828	49	– –	–	–	–	–	–	–	Waldie	1
	Tussac Grass.	Leaves	–	–	Johnston	1	1808	403	29	Johnston	4	–	–	–	12·8	15·5	Johnston	2
		Leaves	–	–	Johnston	1	1792	412	36	– –	–	–	–	–	–	–	– –	–
Seed Crops.	Buck-wheat.	Grain	–	–	Sprengel	1	314	1895	31	Boussingault	1	–	–	–	46·1	55·8	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Canary	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Coriander.	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Carraway.	Seed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	White Mustard.	Seed	–	–	Liebig	1	224	1931	85	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Brown Mustard.	Seed	–	–	Liebig	1	224	1929	87	– –	–	–	–	–	–	–	– –	–
		Straw	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Manufactured Crops.	Hops	Flower	–	–	Way	1	222	1855	163	– –	–	–	–	–	–	–	– –	–
			1187	–	Nesbit	2	289	1669	282	– –	–	–	–	–	–	–	– –	–
			–	–	Cameron & M'Calmont	2	101	1960	179	– –	–	–	–	–	–	–	– –	–
		Bine	1053	Entire	Nesbit	2	222	1810	208	– –	–	–	–	–	–	–	– –	–
	Flax	Stem	–	Straw	Kane	1	314	1830	96	Kane	1	745·9	141·1	931·8	10·8	13·1	– –	–
			–	Fibre	Hodges	1	224	2005	11	– –	–	–	–	–	–	–	– –	–
		Seed	–	–	Thomson	1	318	1767	155	Thomson	1	952·0	138·9	591·4	84·9	102·7	Leo Mayer	1
			–	–	Liebig	1	314	1837	89	Lawes	2	–	–	–	86·7	104·9	Johnston	?
			–	–	Lawes	2	202	1944	94	– –	–	–	–	–	–	–	– –	–
			–	–	Way	4	237	1924	79	Way	4	–	–	–	97·4	117·9	Way	4
	Hemp	Stem	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Seed	–	–	Liebig	1	314	1819	107	– –	–	–	–	–	–	–	– –	–
	Chicory	Root	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Tobacco	Leaf	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. See Note *a*, p. 474.——*b.* Leaves.——*c.* Probably withered.——*d.* Grown by sea-side.——*e.* Grown in a nursery.—— see Note *g*, p. 474.——

D 3.—MISCELLANEOUS CROPS.

PER TON, IN POUNDS.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotized.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	Norton . .	1	Sorby 1 1·1	20·8	13·7		2·0	0·7	–	0·2	–	–	1·1	2·0	4·7	?	-a
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 1 1·1	1·3	4·9	1·6	4·7	0·4	0·02	0·4	0·09	Chl. 1·3		1·1	2·0	?	
–	–	–	–	–	–	–	–	Fromberg .	1	–	0·2	2·9	4·9	5·2	1·3	–	0·2	–	Chl. 1·3		2·9	5·2	?	-b
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel .	1	–	9·0	16·1	5·6	10·8	0·7	0·2	trace	–	Chl. 1·6		5·8	2·0	?	
–	–	–	–	–	–	–	–	Furlong & M'Calmont	2	–	1·8	5·8	2·2	7·4	3·1	–	0·2	–	–	3·8	4·9	2·0	?	
24·6	125·4	–	–	–	116·5	349·4	1212·	Waldie . .	1	–	2·9	13·2	0·1	11·4	2·0	–	0·9	–	Chl. 1·8		1·3	5·6	8·7	-c
	82·8			127·6			192·6	Johnston .	1	–	0·9	4·9	–	1·6	0·9	–	0·2	–	10·3	3·6	2·7	1·8	1·8	-d
–	–	–	–	–	–	–	–	Johnston .	1	–	4·3	6·7	–	3·8	1·8	–	0·9	–	6·0	1·8	3·6	2·0	5·6	-e
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·2	2·7	6·3	2·0	3·4	–	0·4	–	–	–	15·7	0·7	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	Way 3 60·5	2·7	8·3	7·8	17·7	9·4	–	1·1	–	–	0·2	31·1	4·5	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	3	–	0·7	24·9	6·3	7·2	8·3	–	0·9	–	–	1·8	30·4	4·5	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Way . .	1	7·8	37·6	19·7	–	29·3	9·6	–	3·1	–	9·0	–	35·1	11·4	8·7	-f
–	–	–	–	–	–	–	–	Nesbit . .	2	Sorby 1 2·2	64·7	60·5	–	55·3	16·6	–	9·9	2·2	5·4	14·3	30·7	13·2	9·0	
–	–	–	–	–	–	–	–	Cameron & M'Calmont	2	–	19·9	29·3	12·1	32·0	19·3	–	2·2	–	–	9·4	26·4	27·3	?	
–	–	–	–	–	–	–	–	Nesbit . .	–	Sorby 1·8	24·6	23·1	2·5	67·4	11·0	0·2	1·8	trace	2·5	13·9	10·5	7·4	42·6	
–	–	–	–	–	–	–	–	Kane . .	1	–	20·6	9·4	9·4	11·9	7·6	3·8	–	–	Chl. 2·2		10·3	2·7	16·4	-g
–	–	–	–	–	–	–	–	Hodges .	1	–	1·3	–	–	4·9	0·1	–	0·4	–	–	trace	0·9	0·4	3·1	
·0	51·5	–	201·6	26·9 with fibre.	463·7	192·6	784·2	Thomson .	1	–	53·8	26·0	3·4	10·8	12·3	–	4·9	–	trace		39·0	4·5	–	
–	–	277·8	208·3	–	129·9	197·1	1024·8	Liebig . .	1	–	0·7	23·1	0·7	23·3	0·2	–	3·3	–	–	1·3	36·1	0·9	–	h
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	779·5	–	–	–	–	Way . .	2	–	1·1	26·9	1·3	6·7	10·3	–	0·4	–	–	0·2	30·5	1·3	0·2	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	15·0	23·3	0·7	28·7	1·1	–	0·9	–	–	0·9	37·6	0·1	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

f. These samples of hops were in the state as sold; those in the last line only being dried with sulphur.——*g.* Harvested;
h. See Note *i*, p. 476.

D 4.—MISCELLANEOUS CROPS.

Class.	Species.	Parts.	Produce in Tons.	Bushels and Weight per Acre.	General Division.					ENTIRE COMPOSITION								
					In Natural State.					Organic or								
										Ultimate Elements.						Proximate		
																Azotised		
					Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Authority.	Number of Anal.
Soiling Crops.	Oat .	Whole plant, showing ear.	6	–	Norton .	3	10752	2418	270	Völcker .	2	–	–	–	48	57	– –	–
	Rye .	Whole plant, showing ear.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Cabbage	Rape . .	20	–	Johnston	1	40320	4120	360	Boussingault	1	–	–	–	286	346	– –	–
		Cabbage	20	–	Johnston	av.	41220	3100	480	– –	–	–	–	–	–	–	– –	–
	Mustard	Whole plant in blossom.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Comfrey	Whole plant in blossom.	20	–	Sprengel	1	39420	4340	1040	– –	–	–	–	–	–	–	– –	–
	Furze .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Tussac Grass	Leaves .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Seed Crops.	Buck-wheat	Grain .	0·7	28 at 56	Sprengel	1	220	1326	22	Boussingault	1	–	–	–	32	29	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Canary	Seed . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Coriander	Seed . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Carraway	Seed . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	White Mustard	Seed . .	0·8	32 at 56	Liebig .	1	179	1545	68	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Brown Mustard	Seed . .	0·8	32 at 56	Liebig .	1	179	1543	70	– –	–	–	–	–	–	–	– –	–
		Straw .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Manufactured Crops.	Hops .	Flower	0·27	–	Way . .	1	60	501	44	– –	–	–	–	–	–	–	– –	–
			0·27	–	Nesbit .	2	78	451	76	– –	–	–	–	–	–	–	– –	–
			0·27	–	Cameron & M'Calmont	2	27	529	49	– –	–	–	–	–	–	–	– –	–
		Bine . .	0·25	–	Nesbit .	2	56	452	52	– –	–	–	–	–	–	–	– –	–
	Flax .	Stem .	1·5	Straw	Kane . .	1	471	2745	144	Kane . .	1	1119	212	1398	16	19	– –	–
			0·25	Fibre	Hodges .	1	56	501	3	– –	–	–	–	–	–	–	– –	–
		Seed .	0·5	24 at 46	Thomson	1	159	883	78	Thomson .	1	476	69	296	42	51	Leo Mayer	1
			0·5	–	Liebig .	1	157	918	45	Lawes . .	2	–	–	–	44	53	Johnston	?
			0·5	–	Lawes .	2	102	972	47	Way . .	4	–	–	–	49	59	Way . .	4
			0·5	–	Way . .	4	118	962	40	– –	–	–	–	–	–	–	– –	–
	Hemp .	Stem . .	0·25	Fibre	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Seed .	0·7	32 at 48	Liebig .	1	216	1250	74	– –	–	–	–	–	–	–	– –	–
	Chicory	Root . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Leaves .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Tobacco .	Leaf . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. See Note *a*, p. 474.—*b.* Leaves.—*c.* Dried with sulphur.—

D 4.—MISCELLANEOUS CROPS.

PER STATUTE ACRE, IN POUNDS.																							
Combustible Matter.								Inorganic Matter or Ash.															
Elements.																							
Azotised.			Unazotised.																				
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	Norton . .	1	Sorby 1 7	125	82		12	4	–	1	–	–	7	12	28	?	-a
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel .	1	Sorby 1 22	26	98	32	94	8	0·4	8	2	Chl. 26		22	40	?	
–	–	–	–	–	–	–	–	Fromberg .	1	–	4	58	98	104	26	–	4	–	Chl. 26		58	104	?	-b
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Sprengel .	1	–	180	322	112	216	14	4	trace	–	Chl. 32		116	40	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·1	1·9	4·6	1·4	2·4	–	0·3	–	–	–	11·0	0·5	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	Way 3 48·	2·2	6·7	6·3	14·2	7·5	–	0·9	–	–	0·2	24·9	3·6	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	3	–	0·6	19·9	5·1	5·8	6·7	–	0·7	–	–	1·5	24·3	3·6	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Way . .	1	2·1	10·1	5·3	–	7·9	2·6	–	0·8	–	2·4	–	9·5	3·1	2·3	
–	–	–	–	–	–	–	–	Nesbit . .	2	Sorby 1 0·6	17·5	16·3	–	14·9	4·5	–	2·7	0·6	1·5	3·9	8·3	3·6	2·4	
–	–	–	–	–	–	–	–	Cameron & M'Calmont	2	–	5·4	7·9	3·3	8·6	5·2	–	0·6	–	–	2·5	7·1	7·4	?	-c
–	–	–	–	–	–	–	–	Nesbit . .	2	Sorby 1 0·5	6·1	5·8	0·6	16·9	2·8	0·05	0·4	trace	0·6	3·5	2·6	1·9	10·7	
–	–	–	–	–	–	–	–	Kane . .	1	–	30·9	14·1	14·1	17·8	11·4	5·7	–	–	Chl. 3·3		15·4	4·0	24·6	-d
–	–	–	–	–	–	–	–	Hodges .	1	–	0·3	–	–	1·2	0·02	–	0·1	–	–	trace	0·2	0·1	0·8	
23	26	–	101	13	232	96	392	Thomson .	1	–	26·9	13·0	1·7	5·4	6·1	–	2·5	–	trace		19·5	2·3	–	-e
–	–	139	104	With fibre.	65	98	512	Liebig . .	1	–	0·3	11·6	0·3	11·7	0·1	–	1·7	–	–	0·7	18·1	0·5	–	
–	–	–	390	–	–	–	–	Way . .	2	–	0·6	13·4	0·6	3·4	5·2	–	0·2	–	–	0·1	15·2	0·7	0·1	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig . .	1	–	9·3	16·0	0·5	19·7	0·8	–	0·5	–	–	0·5	25·9	0·1	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

d. Harvested; see Note *g*, p. 474.—*e*. See Note *i*, p. 476.

E 1.—SOLID MANURES.

Class.	Species.				General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF EACH — Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Humus.	Inorganic Authority.	Number of Analyses.
Farm Manure.	Farm-yard.	Kent .	–	–	Nesbit . .	1	–	–	–	– –	–	–	–	–	–	–	–	Nesbit . .	1
		Surrey .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	Nesbit . .	1
		Average	–	–	Liebig . .	1	–	68·6	31·4	– –	–	–	–	–	–	–	–	Liebig . .	1
		Bechel-bronn.	–	–	Boussingault	6	–	67·8	32·2	Boussingault	6	52·8	6·2	38·1	2·9	3·5	–	Boussingault	6
		–	–	–	Way . .	1	–	100		Way . .	1	–	–	–	1·7	2·1	–	Way . .	1
	Box .	–	–	–	Way . .	1	–	100		Way . .	1	–	–	–	2·4	2·9	–	Way . .	1
	Stable .	New-castle.	–	–	Richardson	1	–	69·9	30·1	Richardson	1	53·5	7·5	36·5	2·5	3·0	–	Richardson	1
Solid Excrements.	Man .	–	–	–	Playfair .	1	–	86·8	13·2	Playfair .	1	52·1	7·9	40·0		?	–	– –	–
	Horse	–	–	–	Rogers . .	1	–	86·4	13·6	Boussingault and Payen.	1	–	–	–	2·6	3·1	–	Rogers . .	1
		–	–	–	Giradin .	1	–	88·2	11·8	– –	–	–	–	–	–	–	–	– –	–
	Cow .	–	–	–	Thomson .	1	–	90·2	9·8	Thomson .	1	50·7	6·3	41·0	2·0	2·4	–	Haidlen .	1
		–	–	–	Giradin .	1	–	79·2	20·8	Boussingault and Payen.	1	–	–	–	2·9	3·5	–	– –	–
	Sheep .	–	–	–	Giradin .	1	–	74·0	26·0	Boussingault and Payen.	1	–	–	–	4·0	4·8	–	– –	–
	Pig . .	–	–	–	Giradin .	1	–	80·6	19·4	Boussingault and Payen.	1	–	–	–	4·2	5·1	–	– –	–
	Poultry	–	–	–	Giradin .	1	–	59·8	40·2	– –	–	–	–	–	–	–	–	– –	–
	Pigeon	Fresh .	–	–	Giradin .	1	–	86·2	13·8	Boussingault and Payen.	1	–	–	–	10·5	12·7	–	– –	–
		Import-ed from Egypt.	–	–	Johnston .	1	–	65·5	34·5	Johnston .	1	–	–	–	6·8	8·2	–	Johnston .	1
Guano.	Ameri-can.	Peru-vian.	–	–	Way . .	8	–	55·0	45·0	– –	–	–	–	–	–	–	–	Way . .	8
			–	–	Way . .	32	–	60·5	39·5	Way . .	32	–	–	–	27·4	33·1	–	Way . .	32
		Patago-nian.	–	–	Ure and Teschemacher.	14	–	26·2	73·8	Ure and Teschemacher.	14	–	–	–	10·8	13·0	–	Ure and Teschemacher.	14
	African	Saldan-ha Bay.	–	–	Way . .	4	–	20·1	79·9	– –	–	–	–	–	–	–	–	Way . .	4
			–	–	Way . .	9	–	20·6	79·4	Way . .	9	–	–	–	8·1	9·8	–	Way . .	9
			–	–	Ure and Teschemacher.	10	–	18·0	82·0	Ure and Teschemacher.	10	–	–	–	9·0	10·8	–	Ure and Teschemacher.	11
		Ichaboe	Recent		Anderson .	1	–	36·9	63·1	Anderson .	1	–	–	–	29·2	35·4	–	Anderson .	1
			Old		Ure and Teschemacher.	9	–	47·7	52·3	Ure and Teschemacher.	9	–	–	–	17·9	21·6	–	Ure and Teschemacher.	9

a. Professor Way did not give the amount of ash.

E 1.—SOLID MANURES.

PORTION PER CENT.

Matter or Ash.

	Soluble in Rain Water.														Total Inorganic Matter.													
	Abundantly.									Sparingly.																		
Total Sulphur.	Potash.	Soda.	Chlorides	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.	Chloride of Potass.	Silica.	Lime.	Magnesia	Sulph. Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	3·3	0·9	Sod 1·4	?	-	?	1·9	?	–	?	6·9	0·6	–	?	79·8	3·3	0·9	6·9	0·6	0·5	1·0	trace	–	1·4	3·6	1·9	?	
–	5·1	1·7	1·2	?	-	?	1·6	?	–	?	12·3	0·8	–	?	71·3	5·1	1·7	12·3	0·8	0·8	1·0	–	–	1·2	3·6	1·6	?	
–	2·7	2·7	2·7	0·3	-	–	3·6	–	–	0·04	8·2	0·7	–	4·5	66·4	2·7	2·7	8·2	1·0	–	1·8	–	2·7		6·4	3·6	4·5	
–	7·8		Chl 0·6	?	-	?	1·9	–	–	?	8·2	3·6	–	?	66·4	7·8		8·2	3·6	?	?	–	Chl. 0·6		3·0	1·9	?	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–*a*
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	3·2	2·7	Chl 3·2	0·3	-	–	3·3	–	–	0·04	3·4	0·8	–	4·9	59·0	3·2	2·7	8·7	1·9	–	2·4	–	Chl. 3·2		7·8	3·1	4·9	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	3·2									–	–	–	–	–	62·4	11·3	2·0	4·6	3·8	–	1·2	2·1	Chl. 0·03		10·5	1·9	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	trace	–	-	–	–	–	–	–	1·3	–	1·8	–	63·7	–	–	7·6	3·6	–	8·5	–	trace	–	12·5	1·8	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	-	–	–	–	–	–	–	–	–	–	66·5	Salts. 1·2		16·5	?	?	?	–	with Salts		12·4	with Salts.	3·4	–*b*
with Sul Ac	8·0	3·1	0·8	4·7	-	–	–	9·9	–	–	–	–	–	–	3·9	8·0	3·1	29·3	1·6	–	0·8	–	0·8	4·7	37·9	9·9	–	
–	Salts. 25·4				-	–	–	with salts	–	–	–	–	–	–	4·4	Salts. 25·4		Phos. 70·2		–	with Phos	–	with Salts		with Lime and Mag.	with Salts.	–	
–	Salts. 10·3				-	–	–	,,	–	–	–	–	–	–	9·1	Salts. 10·3		Phos. 80·6		–	with Phos	–	,,		,,	,,	–	
with Sul Ac.	4·5		Chl. 1·0		-	–	–	3·6	?	–	–	–	–	–	1·7	4·5		39·2	0·7	–	–	–	Chl. 1·0		47·0	3·6	2·3	
–	Salts. 12·4				-	–	–	with salts	?	–	–	–	–	–	3·6	Salts. 12·4		Phos. 84·0		–	–	–	with Salts		with Lime and Mag.	with Salts.	?	
–	2·5				-	–	–	,,	?	–	–	–	–	–	1·7	Salts. 2·5		Phos. 95·8		–	–	–	,,		,,	,,	?	
–	Salts. 10·2				-	–	–	,,	?	–	–	–	–	–	49·9	Salts. 10·2		Phos. 5·4	30·3	–	?	–	,,		,,	,,	4·2	
–	Salts. 17·9				-	–	–	,,	?	–	–	–	–	–	3·4	Salts. 17·9		Phos. 78·7		–	?	–	,,		,,	,,	?	

——*b*. This had a large quantity of sand mixed with it.

E 2.—SOLID MANURES.

Class.	Species.				General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Authority.	Number of Analyses.
Farm Manure.	Farm-yard.	Kent	–	–	Nesbit . .	1	70·0?	20·8	9·2	– –	–	–	–	–	–	–	–	Nesbit . .	1
		Surrey	–	–	Nesbit . .	1	70·0?	20·4	9·6	– –	–	–	–	–	–	–	–	Nesbit . .	1
		Average	–	–	Liebig . .	1	65·0	24·0	11·0	– –	–	–	–	–	–	–	–	Liebig . .	1
		Bechel-bronn.	–	–	Boussingault	6	79·3	14·0	6·7	Boussingault	6	7·4	0·9	5·3	0·4	0·5	–	Boussingault	6
		– –	–	–	Way . . .	1	71·4	28·6		Way . .	1	–	–	–	0·4	0·5	–	Way . . .	1
	Box	– –	–	–	Way . . .	1	71·0	29·0		Way . .	1	–	–	–	0·6	0·7	–	Way . .	1
	Stable	New-castle (short.)	–	–	Richardson	1	65·2	24·7	10·1	Richardson	1	13·2	1·9	9·0	0·6	0·7	–	Richardson	1
Solid Excrements.	Man	– –	–	–	Playfair .	1	75·0	21·7	3·3	Playfair .	1	11·3	1·7	8·7		?	–	– –	–
	Horse	– –	–	–	Rogers . .	1	77·2	19·7	3·1	Boussingault and Payen.	1	–	–	–	0·5	0·6	–	Rogers . .	1
		– –	–	–	Giradin .	1	78·4	19·1	2·5	– –	–	–	–	–	–	–	–	– –	–
	Cow	– –	–	–	Thomson .	1	86·0	12·6	1·4	Thomson .	1	6·4	0·8	5·2	0·2	0·24	–	Haidlen .	1
		– –	–	–	Giradin. .	1	79·7	16·1	4·2	Boussingault and Payen.	1	–	–	–	0·5	0·6	–	– –	–
	Sheep	– –	–	–	Giradin. .	1	68·7	23·2	8·1	Boussingault and Payen.	1	–	–	–	0·9	1·1	–	– –	–
	Pig	– –	–	–	Giradin. .	1	75·0	20·2	4·8	Boussingault and Payen.	1	–	–	–	0·8	1·0	–	– –	–
	Poultry	– –	–	–	Giradin. .	1	72·0	16·7	11·3	– –	–	–	–	–	–	–	–	– –	–
	Pigeon	Fresh	–	–	Giradin. .	1	79·0	18·1	2·9	Boussingault and Payen.	1	–	–	–	1·9	2·3	–	– –	–
		Imported from Egypt.	–	–	Johnston .	1	6·7	61·1	32·2	Johnston .	1	–	–	–	4·2	5·1	–	Johnston .	1
Guano.	American.	Peru-vian.	–	–	Way . . .	8	14·4	47·1	38·5	– –	–	–	–	–	–	–	–	Way . .	8
			–	–	Way . .	32	13·1	52·6	34·3	Way . .	32	–	–	–	14·4	17·4	–	Way . .	32
		Pata-gonian.	–	–	Ure and Tes-chemacher.	14	25·1	19·6	55·3	Ure and Tes-chemacher.	14	–	–	–	2·1	2·5	–	Ure and Tes-chemacher.	14
	African	Sal-danha Bay.	–	–	Way . .	4	13·1	17·5	69·4	– –	–	–	–	–	–	–	–	Way . .	4
			–	–	Way . .	9	16·9	17·1	66·0	Way . .	9	–	–	–	1·4	1·7	–	Way . .	9
			–	–	Ure and Tes-chemacher.	10	26·9	13·2	59·9	Ure and Tes-chemacher.	10	–	–	–	1·1	1·4	–	Ure and Tes-chemacher.	11
		Ichaboe	Recent		Anderson .	1	17·4	30·5	52·1	Anderson .	1	–	–	–	8·9	10·8	–	Anderson .	1
			Old.		Ure and Tes-chemacher.	9	27·4	34·6	38·0	Ure and Tes-chemacher.	9	–	–	–	6·2	7·5	–	Ure and Tes-chemacher.	9

a. These analyses were instituted for the sake of comparing box and yard manure; but it is right to add that the manner
the phosphates of lime and magnesia. I may here mention that it is impossible to ascertain the amount with chemical

E 2.—SOLID MANURES.

COMPOSITION PER CENT.

Matter or Ash.

	Soluble in Rain Water.														Total Inorganic Matter.													
	Abundantly.									Sparingly.																		
Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia	Iron.	Ph. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	0·30	0·08	–	0·13	–	–	?	0·17	?	?	0·63	0·06	–	?	7·34	0·30	0·08	0·63	0·06	0·05	0·09	trace	–	0·13	0·33	0·17	?	
–	0·49	0·16	–	0·12	–	–	?	0·16	?	?	1·18	0·08	–	?	6·84	0·49	0·16	1·18	0·08	0·08	0·10	–	–	0·12	0·35	0·16	?	
–	0·30	0·30	0·30		0·03	–	–	0·40	?	0·004	0·90	0·07	–	0·50	7·30	0·30	0·30	0·90	0·10	–	0·20	–	0·30		0·70	0·40	0·50	
–	0·52		Chl. 0·04		?	–	?	0·13	?	?	0·55	0·24	–	?	4·45	0·52		0·55	0·24	?	?	–	Chl. 0·04		0·20	0·13	?	
–	Salts 2·8									–	–	–	–	–	–	0·80		–	–	–	–	–	–	–	0·26	–	–	a
–	Salts 4·3									–	–	–	–	–	–	2·00		–	–	–	–	–	–	–	0·30	–	–	
–	0·33	0·29	Chl. 0·33		0·03	–	–	0·33	–	0·004	0·35	0·08	–	0·52	6·06	0·33	0·29	0·99	0·19	–	0·21	–	Chl. 0·33		0·81	0·33	0·52	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	0·10									–	–	–	–	–	1·93	0·35	0·06	0·14	0·12	–	0·04	0·07	Chl. 0·0009		0·33	0·06	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	0·02	–	0·03	–	0·89	–	–	0·11	0·05	–	0·12	–	trace	–	0·18	0·03	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	Salts 0·4				–	–	–	with salts	–	–	1·3	–	–	1·1	21·4	Salts 0·4		5·3?		–	?	–	with salts		4·0	with Salts.	1·1	b
with Sul Ac	3·1	1·2	0·3	1·8	–	–	–	3·8	–	–	–	–	–	–	1·5	3·1	1·2	11·3	0·6	–	0·3	–	0·3	1·8	14·6	3·8	–	
–	Salts 8·7				–	–	–	with salts	–	–	–	–	–	–	1·5	Salts 8·7		Phos. 24·1		–	with Phos	–	with salts		with lime & mag.	with Salts.	–	
–	Salts 5·7				–	–	–	,,	–	–	–	–	–	–	5·0	Salts 5·7		Phos. 44·6		–	,,	–	,,		,,	,,	–	
–	3·1		Chl. 0·7		–	–	–	2·5	1·6	–	–	–	–	–	1·2	3·1		27·2	0·5	–	–	–	Chl. 0·7		32·6	2·5	1·6	
–	Salts 8·2				–	–	–	with salts	?	–	–	–	–	–	2·4	Salts 8·2		Phos. 55·4		–	?	–	with salts		with lime & mag.	with Salts.	?	
–	Salts 1·5				–	–	–	,,	–	–	–	–	–	–	1·0	Salts 1·5		Phos. 57·4		–	?	–	,,		,,	,,	?	
–	5·3				–	–	–	,,	–	–	–	–	–	–	26·0	Salts 5·3		Phos 2·8	15·8	–	?	–	,,		,,	,,	2·2	
–	Salts 6·8				–	–	–	,,	?	–	–	–	–	–	1·3	Salts 6·8		Phos. 29·9		–	?	–	,,		,,	,,	?	

of feeding the animals on the two farms was not determined.——*b*. I have calculated the amount of phosphoric acid as half correctness, on account of the vague way in which chemists use the term phosphate instead of stating which salt is intended.

E 3.—SOLID MANURES.

Class.	Species.				General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic. Authority.	Number of Analyses.
Farm Manure.	Farm-yard.	Kent .	–	–	Nesbit . .	1	1568	466	206	– –	–	–	–	–	–	–	–	Nesbit . .	1
		Surrey.	–	–	Nesbit . .	1	1568	457	215	– –	–	–	–	–	–	–	–	Nesbit . .	1
		Average	–	–	Liebig . .	1	1456	[a]538	246	– –	–	–	–	–	–	–	–	Liebig . .	1
		Bechel-bronn.	–	–	Boussingault	6	1776	314	150	Boussingault	6	166	20	119	9	11	–	Boussingault	6
		–	–	–	Way . . .	1	1599	641		Way . .	1	–	–	–	9	11	–	Way . . .	1
	Box .	–	–	–	Way . . .	1	1590	650		Way . .	1	–	–	–	13	16	–	Way . . .	1
	Stable .	New-castle (short).	–	–	Richardson	1	1461	553	226	Richardson	1	296	42	202	13	16	–	Richardson	1
Solid Excrements.	Man .	–	–	–	Playfair .	1	1680	486	74	Playfair .	1	253	38	195		?	–	– –	–
	Horse	–	–	–	Rogers . .	1	1729	441	70	Boussingault and Payen.	1	–	–	–	11	13	–	Rogers . .	–
		–	–	–	Giradin. .	1	1756	428	56	– –	–	–	–	–	–	–	–	– –	–
	Cow .	–	–	–	Thomson .	1	1926	282	32	Thomson .	1	143	18	116	4	5	–	Haidlen .	1
		–	–	–	Giradin. .	1	1785	361	94	Boussingault and Payen.	1	–	–	–	11	13	–	– –	–
	Sheep .	–	–	–	Giradin. .	1	1539	520	181	Boussingault and Payen.	1	–	–	–	20	24	–	– –	–
	Pig . .	–	–	–	Giradin. .	1	1680	452	108	Boussingault and Payen.	1	–	–	–	18	22	–	– –	–
	Poultry	–	–	–	Giradin. .	1	1613	374	253	– –	–	–	–	–	–	–	–	– –	–
	Pigeon	Fresh .	–	–	Giradin. .	1	1770	405	65	Boussingault and Payen.	1	–	–	–	43	52	–	– –	–
		Imported from Egypt.	–	–	Johnston .	1	150	1369	721	Johnston .	1	–	–	–	94	114	–	Johnston .	1
Guano.	American.	Peruvian.	–	–	Way . . .	8	323	1055	862	– –	–	–	–	–	–	–	–	Way . . .	8
			–	–	Way . . .	32	294	1178	768	Way . . .	32	–	–	–	322	390	–	Way . . .	32
		Patagonian.	–	–	Ure and Teschemacher.	14	562	439	1239	Ure and Teschemacher.	14	–	–	–	47	56	–	Ure and Teschemacher.	14
	African	Saldanha Bay.	–	–	Way . . .	4	293	392	1555	– –	–	–	–	–	–	–	–	Way . . .	4
			–	–	Way . . .	9	379	383	1478	Way . .	9	–	–	–	31	38	–	Way . . .	9
			–	–	Ure and Teschemacher.	10	602	296	1342	Ure and Teschemacher.	10	–	–	–	25	31	–	Ure and Teschemacher.	11
		Ichaboe	Recent		Anderson .	1	390	683	1167	Anderson .	1	–	–	–	199	240	–	Anderson .	1
			Old		Ure and Teschemacher.	9	614	775	851	Ure and Teschemacher.	9	–	–	–	139	168	–	Ure and Teschemacher.	9

a. This is an analysis of the dung of well-fed horses,

E 3.—SOLID MANURES.

ER TON, IN POUNDS.

Matter or Ash.

	Soluble in Rain Water.														Total Inorganic Matter.												
	Abundantly.									Sparingly.																	
Total Sulphur.	Potash.	Soda.	Chl. of Potas.	Chl. of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carb. Acid.	Silica.	Lime.	Magnesia.	Sulph. Acid.	Carb. Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	7	2	–	3	–	–	?	4	?	?	14	1	–	?	165	7	2	14	1	1	2	trace	–	3	7	4	?
–	11	4	–	3	–	–	?	4	?	?	26	2	–	?	153	11	4	26	2	2	2	–	–	3	8	4	?
–	7	7	7		0·7	–	?	9	?	0·09	20	1	–	11	163	7	7	20	2	–	4	–	7		16	9	11
–	12		Chl. 1		?	–	?	3	?	?	12	5	–	?	100	12		12	5	?	?	–	Chl. 1		5	3	?
–					salts 63					–	–	–	–	–	–	18		–	–	–	–	–	–	–	6	–	–
–					salts 96					–	–	–	–	–	–	45		–	–	–	–	–	–	–	7	–	–
–	7	7	Chl. 7		0·7	–	?	7	?	0·09	8	2	–	11	135	7	7	22	4	–	4	–	Chl. 7		18	7	11 –a
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	8	1	3	3	–	1	2	Chl. 0·2		7	1	?
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20	–	–	2	1	–	3	–	trace	–	4	·1	?
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	Salts 9				–	–	–	with salts	–	–	29	–	–	25	479	Salts 9		119	?	–	?	–	with salts		90	with Salts	25
–	70	27	7	40	–	–	–	85	–	–	–	–	–	–	34	70	27	253	13	–	7	–	7	40	327	85	–
–	Salts 195				–	–	–	with salts	–	–	–	–	–	–	34	Salts 195		Phos. 540		–	with phos	–	with salts		Lime and Mag.	with Salts	–
–	Salts 128				–	–	–	,,	–	–	–	–	–	–	112	Salts 128		Phos. 999		–	,,	–	,,		,,	,,	–
–	69		Chl. 16		–	–	–	56	36 ?	–	?	–	–	?	27	69		609	11	–	–	–	Chl. 16		730	56	36
–	Salts 184				–	–	–	with salts	–	–	–	–	–	–	54	Salts 184		Phos. 1241		–	?	–	with salts		with Lime and Mag.	with Salts	?
–	Salts 34				–	–	–	,,	–	–	–	–	–	–	22	Salts 34		Phos. 1286		–	?	–	,,		,,	,,	?
–	Salts 119				–	–	–	,,	–	–	63	–	–	49	582	Salts 119		Phos. 63 | 354		–	?	–	,,		,,	,,	49
–	Salts 152				–	–	–	,,	–	–	–	–	–	–	29	Salts 152		Phos. 670		–	?	–	,,		,,	,,	?

fermented so as to be able to cut it with a spade.

E 3.—SOLID MANURES.

E 3.—SOLID MANURES.

ENTIRE COMPOSITION PER TON, IN POUNDS.

Class.	Species.				General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Matter or Ash. Authority.	Number of Analyses.
Farm Manure.	Farm-yard.	Kent .	–	–	Nesbit . .	1	1568	466	200	— —	–	–	–	–	–	–	–	Nesbit . .	1
		Surrey.	–	–	Nesbit . .	1	1568	457	215	— —	–	–	–	–	–	–	–	Nesbit . .	1
		Average	–	–	Liebig . .	1	1456	538	246	— —	–	–	–	–	–	–	–	Liebig . .	1
		Bechel-bronn.	–	–	Boussingault	6	1776	314	150	Boussingault	6	166	20	119	9	11	–	Boussingault	6
		–	–	–	Way . . .	1	1599	641		Way . .	1	–	–	–	9	11	–	Way . . .	1
	Box .	–	–	–	Way . . .	1	1590	630		Way . .	1	–	–	–	13	16	–	Way . . .	1
	Stable .	New-castle (short).	–	–	Richardson	1	1461	533	226	Richardson	1	296	42	202	13	16	–	Richardson	1
Solid Excrements.	Man .	–	–	–	Playfair .	1	1680	486	74	Playfair .	1	253	38	195		?	–	— —	–
	Horse	–	–	–	Rogers . .	1	1729	441	70	Boussingault and Payen.	1	–	–	–	11	13	–	Rogers . .	–
		–	–	–	Giradin. .	1	1756	426	56	— —	–	–	–	–	–	–	–	— —	–
	Cow .	–			Thomson .	[illegible]	[illegible]	[illegible]	22	Thomson .	[illegible]	[illegible]	[illegible]	[illegible]	4	5	–	Haidlen .	1
		–	–	–	Giradin. .	1	1763	361	94	Boussingault and Payen.	1	–	–	–	11	13	–	— —	–
	Sheep .	–	–	–	Giradin. .	1	1539	520	181	Boussingault and Payen.	1	–	–	–	20	24	–	— —	–
	Pig . .	–	–	–	Giradin. .	1	1680	452	108	Boussingault and Payen.	1	–	–	–	18	22	–	— —	–
	Poultry	–	–	–	Giradin. .	1	1613	374	253	— —	–	–	–	–	–	–	–	— —	–
	Pigeon	Fresh .	–	–	Giradin. .	1	1770	405	65	Boussingault and Payen.	1	–	–	–	43	52	–	— —	–
		Imported from Egypt.	–	–	Johnston .	1	150	1369	721	Johnston .	1	–	–	–	94	114	–	Johnston .	1
Guano.	American	Peruvian.	–	–	Way . . .	8	323	1055	862	— —	–	–	–	–	–	–	–	Way . . .	8
			–	–	Way . . .	32	294	1178	768	Way . . .	32	–	–	–	322	390	–	Way . . .	32
		Patagonian.	–	–	Ure and Teschemacher	14	562	439	1239	Ure and Teschemacher	14	–	–	–	47	56	–	Ure and Teschemacher.	14
	African	Saldanha Bay.	–	–	Way . . .	4	293	392	1555	— —	–	–	–	–	–	–	–	Way . . .	4
			–	–	Way . . .	9	379	383	1478	Way . .	9	–	–	–	31	38	–	Way . . .	9
			–	–	Ure and Teschemacher.	10	602	296	1342	Ure and Teschemacher.	10	–	–	–	25	31	–	Ure and Teschemacher.	11
		Ichaboe	Recent		Anderson .	1	390	693	1157	Anderson .	1	–	–	–	199	240	–	Anderson .	1
			Old		Ure and Teschemacher.	9	614	775	851	Ure and Teschemacher.	9	–	–	–	139	168	–	Ure and Teschemacher.	9

Inorganic Matter or Ash (continued).

Species / Authority	Total Sulphur.	Soluble in Rain Water. Abundantly. Potash.	Soda.	Chl. of Potass.	Chl. of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carb. Acid.	Sparingly. Silica.	Lime.	Magnesia.	Sulph. Acid.	Carb. Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
Kent (Nesbit)	–	7	2	–	5	–	–	?	4	[illegible]	[illegible]	14	1	–	?	165	7	[illegible]	14	1	1	2	trace	–	1	7	4	?
Surrey (Nesbit)	–	11	4	–	3	–	–	?	4	[illegible]	[illegible]	26	2	–	[illegible]	153	11	4	[illegible]	2	2	2	–	–	1	8	[illegible]	?
Average (Liebig)	–	7	7	7		0·7	–	?	9	?	0·09	[illegible]	1	–	11	163	7	7	[illegible]	[illegible]	–	4	–	7		16	9	11
Bechelbronn (Boussingault)	–	12		Chl. 1		?	–	[illegible]	3	[illegible]	?	12	5	–	?	160	12		12	[illegible]	[illegible]	[illegible]	–	Chl. [illegible]		[illegible]	[illegible]	?
Farm-yard (Way)	–					salts 61					–	–	–	–	–	–	18		–	[illegible]	–	–	–	–	–	6	–	–
Box (Way)	–					salts 96					–	–		–	–	–	45		–	–	–	–	–	–	–	7	–	–
Stable (Richardson)	–	7	7	Chl. 7		0·7	–	[illegible]	7	?	[illegible]	8	2	–	11	[illegible]	7	7	22	4	–	4	–	Chl. 7		18	7	11 [a]
Man (Playfair)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Horse (Rogers)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	8	1	3	3	–	1	2	Chl. [illegible]		7	1	?
Horse (Giradin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cow (Thomson)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20		–	2	1	–	3	–	trace	–	4	[illegible]	?
Cow (Giradin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sheep (Giradin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pig (Giradin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Poultry (Giradin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pigeon, Fresh (Giradin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pigeon, Egypt (Johnston)	–	Salts 9				–	–	and salts	–	–	29	–	–	25	479	Salts 9		17	7	[illegible]	?	–	with salts		99	with Salts	25
Peruvian (Way, 8)	–	19	27	7	40		–	–	50	–	–	–	–	–	–	34	70	27	533	13	–	7	–	7	40	337	85	–
Peruvian (Way, 32)	–	Salts 195				–	–	–	with salts	–			–	–	–	34	Salts 195		Phos. 540		–	with phos.	–	with salts		Lime and Mag.	with Salts	–
Patagonian (Ure and Teschemacher)	–	Salts 128					–	–	..	–	–	–	–	–	–	112	Salts 128		Phos. 999		–	..	–	..		..	..	–
Saldanha Bay (Way, 4)	–	69		Chl. 17			–	–	56	46	–	?	–	–	?	27	69		609	11	–	–	–	Chl. 16		750	56	36
Saldanha Bay (Way, 9)	–	Salts 184				–	–	–	with salts	–			–	–	–	54	Salts 184		Phos. 1241			[illegible]	–	with salts		with Lime and Mag.	with Salts	?
African (Ure and Teschemacher)	–	Salts 31				–	–	–	..	–	–	–		–	–	25	Salts 31		Phos. 1258				–	..		..	..	[illegible]
Ichaboe, Recent (Anderson)	–	Salts 119					–	–	..	–	–	63	–	–	45	592	Salts 119		Phos. 631	51	–	..	–	..		..	..	43
Ichaboe, Old (Ure and Teschemacher)	–	Salts 152				–	–	–	..	–	–	–	–	–	–	29	Salts [illegible]		Phos. 675				–	..		..	..	?

a. This is an analysis of the dung of well-fed horses, fermented so as to be able to cut it with a spade.

E 4.—SOLID MANURES.

Class.	Species.		Tons.	Cwt.	General Division.					ENTIRE COMPOSITION									
					In Natural State.					Organic Matter.								Inorganic	
										Ultimate Elements.									
					Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Authority.	Number of Analyses.
Farm Manure.	Farm-yard.	Kent .	20	–	Nesbit . .	1	31360	9320	4120	– –	–	–	–	–	–	–	–	Nesbit .	1
		Surrey .	20	–	Nesbit . .	1	31360	9140	4300	– –	–	–	–	–	–	–	–	Nesbit .	1
		Average	20	–	Liebig, &c.	1	29120	10760	4920	– –	–	–	–	–	–	–	–	Liebig .	1
		Bechel-bronn.	20	–	Boussingault	6	35520	6280	3000	Boussingault	6	3320	400	2380	180	218	–	Boussin-gault.	6
		– –	20	–	Way . .	1	31980	12820		Way . .	1	–	–	–	180	218	–	Way . .	1
	Box .	– –	20	–	Way . .	1	31800	13000		Way . .	1	–	–	–	260	315	–	Way . .	1
	Stable .	New-castle (short).	20	–	Richardson	1	29220	11060	4520	Richardson	1	5920	840	4040	260	315	–	Richardson	1
Solid Excrements.	Man .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Horse .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Cow .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Sheep .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Pig . .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Poultry	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Pigeon	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
Guano.	American.	Peruvian.	–	3	Way . .	8	49	158	129	– –	–	–	–	–	–	–	–	Way . .	8
			–	3	Way . .	32	44	177	115	Way . .	32	–	–	–	48	58	–	Way . .	32
		Patagonian.	–	3	Ure and Teschemacher.	14	84	66	186	Ure and Teschemacher.	14	–	–	–	7	9	–	Ure & Teschemacher.	14
	African	Saldanha Bay.	–	3	Way . .	4	44	59	233	– –	–	–	–	–	–	–	–	Way . .	4
			–	3	Way . .	9	57	57	222	Way . .	9	–	–	–	5	6	–	Way . .	9
			–	3	Ure and Teschemacher.	10	90	45	201	Ure and Teschemacher.	10	–	–	–	4	5	–	Ure & Teschemacher.	11
		Ichaboe	–	3	Anderson .	1	58	103	175	Anderson .	1	–	–	–	30	36	–	Anderson	1
			–	3	Ure and Teschemacher.	9	92	116	128	Ure and Teschemacher.	9	–	–	–	21	25	–	Ure & Teschemacher.	9

a. These excrements not being generally applied to the land by themselves,

E 4.—SOLID MANURES.

ER STATUTE ACRE, IN POUNDS.

atter or Ash.

	Soluble in Rain Water.														Total Inorganic Matter.												
	Abundantly.									Sparingly.																	
Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia.	Iron.	Phosph. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	140	40	–	60	–	–	?	80	?	?	280	20	?	?	3300	140	40	280	20	20	40	trace	–	60	140	80	?
–	220	80	–	60	–	–	?	80	?	?	520	40	?	?	3060	220	80	520	40	40	40	–	–	60	160	80	?
–	140	140	140		14	–	?	180	?	2	400	20	–	220	3260	140	140	400	40	?	80	–	140		320	180	220
–	240		Chl. 20		?	–	?	60	?	?,	240	100	?	?	2000	240		240	100	?	?	–	Chl. 20		100	60	?
–					1260					–	–	–	–	–	–	360		–	–	–	–	–	–	–	120	–	–
–					1920					–	–	–	–	–	–	900		–	–	–	–	–	–	–	140	–	–
–	140	140	140		14	–	?	140	?	2	160	40	–	220	2700	140	140	440	80	?	80	–	Chl. 140		360	140	220
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	– —*a*
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	10	4	1	6	–	–	–	13	–	–	–	–	–	–	5	10	4	38	2	–	1	–	1	6	49	13	–
–	Salts 29				–	–	?	With Salts.	–	–	–	–	–	–	5	Salts 29		Phos. 81		–	With Phos.	–	With salts		With Lime and Mag.	With Salts	–
–	Salts 19				–	–	?	,,	–	–	–	–	–	–	17	Salts 19		Phos. 150		–	,,	–	,,		,,	,,	–
–	10		Chl. 2		–	–	?	8	6	–	?	–	–	?	4	10		92	2	–	–	–	Chl. 2		109	8	6
–	Salts 28				–	–	?	With Salts.	?	–	–	–	–	–	8	Salts 28		Phos. 185		–	?	–	With salts		With Lime and Mag.	With Salts	?
–	Salts 5				–	–	?	,,	?	–	–	–	–	–	3	Salts 5		Phos. 193		–	?	–	,,		,,	,,	?
–	Salts 18				–	–	?	,,	?	–	9	–	–	7	87	Salts 18		Phos. 9	54	–	?	–	,,		,,	,,	7
–	Salts 23				–	–	?	,,	?	–	–	–	–	–	4	Salts 23		Phos. 101		–	?	–	,,		,,	,,	?

I have thought it unnecessary to calculate the amount for an acre.

E 4.—SOLID MANURES.

E 4.—SOLID MANURES.

ENTIRE COMPOSITION PER STATUTE ACRE, IN POUNDS.

Class.	Species.		Tons.	Cwt.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Matter or Ash. Authority.	Number of Analyses.
Farm Manure.	Farm-yard	Kent	20	—	Nesbit	1	31360	9320	4120	— —	—	—	—	—	—	—	—	Nesbit	1
		Surrey	20	—	Nesbit	1	31360	9140	4300	— —	—	—	—	—	—	—	—	Nesbit	1
		Average	20	—	Liebig, &c.	1	29120	10760	4920	— —	—	—	—	—	—	—	—	Liebig	1
		Bechelbronn	20	—	Boussingault	6	35520	[illegible]	3000	Boussingault	6	3320	400	2380	180	218	—	Boussingault	6
		— —	20	—	Way	1	31980	12820		Way	1	—	—	—	[illegible]	218	—	Way	1
	Box	— —	20	—	Way	1	31800	3000		Way	1	—	—	—	220	115	—	Way	1
	Stable	Newcastle short	20	—	Richardson	1	29220	11060	4520	Richardson	1	5920	840	4040	260	315		Richardson	1
Solid Excrements.	Man	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Horse	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Cow	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Sheep	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Pig	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Poultry	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Pigeon	— —	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
Guano.	American	Peruvian	—	3	Way	8	49	158	129	— —	—	—	—	—	—	—	—	Way	8
		Peruvian	—	3	Way	32	44	177	115	Way	32	—	—	—	48	58	—	Way	32
		Patagonian	—	3	Ure and Teschemacher.	14	84	66	186	Ure and Teschemacher.	14	—	—	—	7	9	—	Ure & Teschemacher.	14
	African	Saldanha Bay.	—	3	Way	4	44	59	233	— —	—	—	—	—	—	—	—	Way	4
		Saldanha Bay.	—	3	Way	9	67	57	222	Way	9	—	—	—	5	6	—	Way	9
		Saldanha Bay.	—	3	Ure and Teschemacher.	10	90	45	201	Ure and Teschemacher.	10	—	—	—	4	5	—	Ure & Teschemacher.	11
		Ichaboe	—	3	Anderson	1	56	103	173	Anderson	1	—	—	—	34	37	—	Anderson	1
		Ichaboe	—	3	Ure and Teschemacher.	9	92	110	128	Ure and Teschemacher	9	—	—	—	21	[illegible]	—	Ure & Teschemacher.	9

Species.	Total Sulphur	Soluble in Rain Water. Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.	Magnesia.	Iron.	Phosph. Acid.	Sulphuric Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Total Inorganic Matter. Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
Farm-yard, Kent	—	140	40	—	60	—	—	?	80	?	?	280	20	?	?	3300	140	40	280	20	20	40	trace	—	60	140	80	?
Farm-yard, Surrey	—	220	80	—	60	—	—	?	80	?	?	520	40	?	?	3060	220	80	520	40	40	40	—	—	60	160	80	?
Farm-yard, Average	—	140	140	140		14	—	?	180	?	2	40	20	—	220	3260	140	140	400	40	?	80	—	140		320	180	220
Farm-yard, Bechelbronn	—	240		Chl. 20		?	—	?	60	?	1	240	60	?	?	2000	240		240	100	?	?	—	Chl. 20		[illegible]	60	?
Farm-yard, — —	—					1290					—	—	—	—	—	—	360		—	—	—	—	—	—	—	20	—	—
Box	—					1920					—	—	—	—	—	—	900		—	—	—	—	—	—	—	140	—	—
Stable, Newcastle short	—	140	140	140		14	—	?	140	?	2	160	40	—	220	2700	140	140	440	60	?	80	—	Chl. 140		360	140	220
Man	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	— *a*
Horse	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cow	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sheep	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pig	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Poultry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pigeon	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Guano, Peruvian (Way, 8)	—	10	4	1	6	—	—	—	13	—	—	—	—	—	—	5	10	4	38	2	—	1	—	1	6	49	13	—
Guano, Peruvian (Way, 32)	—	Salts 29				—	—	?	With Salts.	—	—	—	—	—	—	5	Salts 29		Phos. 81		—	With Phos.	—	With salts		With Lime and Mag	With Salts	—
Guano, Patagonian	—	Salts 19				—	—	?	..	—	—	—	—	—	—	17	Salts 19		Phos. 150		—	..	—	..		..	..	—
Guano, Saldanha Bay (Way, 4)	—	10		Chl. 2		—	—	?	8	6	—	?	—	—	?	4	10		92	2	—	—	—	Chl. 2		109	8	6
Guano, Saldanha Bay (Way, 9)	—	Salts 28				—	—	?	With Salts	?	—	—	—	—	—	8	Salts 29		Phos. 18[illegible]		—	?	—	With salts		With Lime and Mag.	With Salts	?
Guano, Saldanha Bay (Ure and Teschemacher)	—	Salts 5				—	—	?	..	?	—	—	—	—	—	3	Salts 5		Phos. 121		—	?	—	..		..	..	?
Guano, Ichaboe (Anderson)	—	Salts 18				—	—	?	..	?	—	9	—	—	7	8	Salts 18		Phos. [illegible]		—	?	—	..		..	..	?
Guano, Ichaboe (Ure and Teschemacher)	—	Salts 23				—	—	?	..	?	—	—	—	—	—	4	Salts 23		Phos. [illegible]		—	?	—	..		..	..	?

a. These excrements not being generally applied to the land by themselves, I have thought it unnecessary to calculate the amount for an acre.

F 1.—SPECIAL MANURES, &c.

Class.	Species.			General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF EACH — Organic Matter. Authority.	Ultimate Elements. Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Authority.	Number of Analyses.	Total Sulphur.
Charcoal.	Animal	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–	–
	Peat.	– –	–	Phillips .	1	–	88·4	11·6	Phillips .	1	89·7	2·4	7·3	0·6	0·7	–	Phillips .	1	–
		– –	–	Sir R. Kane	1	–	95·8	4·2	Sir R. Kane	1	93·8	1·8	4·4		?	–	– –	–	–
	Wood .	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–	–
Ashes.	Wood .	Farnham	–	Nesbit .	1	–	0·4	99·6	– –	–	–	–	–	–	–	–	Nesbit .	1	–
	Peat.	Dutch .	–	Richardson	1	–	32·5	67·5	– –	–	–	–	–	–	–	–	Richardson	1	–
		Farnham	–	Nesbit .	1	–	17·0	83·0	– –	–	–	–	–	–	–	–	Nesbit .	1	–
	Coal .	Dunfermline	–	Johnston	3	–	–	100·0	– –	–	–	–	–	–	–	–	Johnston	3	–
	Sea-weed (kelp).	Tangle .	–	Hodges .	2	–	66·0	34·0	– –	–	–	–	–	–	–	–	Hodges .	1	–
		Kelp. .	–	Hodges .	1	–	–	100·0	– –	–	–	–	–	–	–	–	Hodges .	1	–
Bones.	Fresh	– –	–	Anderson	3	–	45·9	54·1	Johnston	1	50·4	6·3	25·4	17·9	21·7	–	Johnston	1	–
		– –	–	Thomson	2	–	45·9	54·1	– –	–	–	–	–	–	–	–	Thomson	2	–
	Bones and Sulph. Acid.	Unburnt	–	Richardson	1	–	25·0	75·0	Richardson	1	47·9	9·4	21·9	20·8	25·2	–	Richardson	1	–
		Burnt .	–	Richardson	1	–	–	100·0	– –	–	–	–	–	–	–	–	Richardson	1	–
Salts.	Chl. of Sodium (Common Salt).	Cheshire.	–	Johnston	1	–	–	100·	– –	–	–	–	–	–	–	–	Johnston	1	–
		Bay . .	–	Henry .	3	–	–	100·	– –	–	–	–	–	–	–	–	Henry .	3	–
		Sea, Br. .	–	Henry .	4	–	–	100·	– –	–	–	–	–	–	–	–	Henry .	4	–
	Potash	Nitrate, Saltpetre	–	Parkes .	1	–	–	100·	– –	–	–	–	–	–	–	–	Parkes .	1	–
			–	Wilson .	1	–	–	100·	– –	–	–	–	–	–	–	–	Wilson .	1	–
		Sulphate	–	Parkes .	1	–	–	100·	– –	–	–	–	–	–	–	–	Parkes .	1	–
		Carbona., Pearlash	–	Parkes .	1	20·5	–	79·5	– –	–	–	–	–	–	–	–	Brande .	1	–
	Soda	Nitrate, Cubic Nitre .	–	Brande .	1	–	–	100·	– –	–	–	–	–	–	–	–	Brande .	1	–
			–	Wilson .	1	–	–	100·	– –	–	–	–	–	–	–	–	Wilson .	1	–
		Sulphate, Glauber Salts.	–	Brande .	1	55·6	–	44·4	– –	–	–	–	–	–	–	–	Brande .	1	–
		Carbonate	–	Brande .	1	62·5	–	37·5	– –	–	–	–	–	–	–	–	Brande .	1	–
	Lime	Sulphate, Gypsum	–	Brande .	1	21·0	–	79·0	– –	–	–	–	–	–	–	–	Brande .	1	–
	Magnesia.	Sulphate, Epsom Salts.	–	Brande .	1	51·2	–	48·8	– –	–	–	–	–	–	–	–	Brande .	1	–
	Ammonia.	Sulphate	–	Brande .	1	24·0	–	76·0	Brande .	–	–	–	–	18·8	22·7	–	Brande .	1	–
		Muriate, Sal Ammoniac.	–	Brande .	1	–	–	100·	Brande .	1	–	–	–	26·0	31·5	–	Brande .	1	–
		Carbona., Smelling Salts.	–	R. Phillips	1	15·2	–	84·8	R. Phillips	1	–	–	–	23·8	28·8	–	R. Phillips	1	–

a. The solubility of these salts is only conjectural, the analysis not having stated their relative solubility.——*b.* There is a farmers.——*c.* Refined rock salt.——*d.* The amount of water said to be contained in some of these salts is in a state of to a red heat, whereby the water of crystallization is expelled.——*e.* The salts of ammonia are decomposed by heat, and

F 1.—SPECIAL MANURES, &c.

…RTION PER CENT.																											
…ter or Ash.																											
	Soluble in Rain-Water.													Total Inorganic Matter.													
	Abundantly.								Sparingly.																		
	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia.	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulph. Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	–	–	22·4	–	–	–	–	–	?	14·4	–	7·5	7·2	24·1	6·5	–	14·4	–	with sand	14·7	–	–	22·4	3·0	7·5	7·2	
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
6	4·9	–	0·8	?	?	?	3·3	?	?	29·1	6·6	?	25·3	14·3	7·6	4·9	29·1	6·6	0·2	1·5	trace	–	0·8	6·0	3·3	25·3	–a
e	2·5	Chl. 0·7		–	–	?	?	?	?	20·9	trace	17·0	4·1	53·0	trace	2·5	20·9	trace	–	–	–	Chl. 0·7		1·7	17·0	4·1	
	–	0·7	0·5	–	–	?	–	–	?	6·4	0·1	3·9	3·0	62·2	–	–	6·4	0·1	5·3	16·3	–	0·7	0·5	0·7	3·9	3·0	
1·2 ?		–	–	–	–	?	?	?	?	13·6	1·7	2·5	9·6	48·5	1·2		13·6	1·7	6·9	13·5	–	–	–	0·9	2·5	9·6	
	–	–	–	–	–	–	–	–	–	–	–	–	–	2·7	8·2	25·8	5·2	8·5	–	–	–	Chl. 11·7		5·4	20·2	?	–b
2	25·8	Chl. 11·7		?	–	?	?	?	?	5·2	8·5	20·2	?	2·7	8·2	25·8	5·2	8·5	–	?	–	Chl. 11·7		5·4	20·2	?	
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5·2	39·7	1·6	–	–	–	Chl. 1·0		49·5	–	2·4	
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·2	0·4	41·7	1·1	–	–	–	–	–	49·8	–	2·3	
	–	–	–	–	–	22·4	?	–	–	24·0	–	47·8	–	–	–	–	24·0	1·0	–	trace	–	Chl. 4·7		22·4	47·8	–	
	–	–	–	–	–	12·8	?	–	–	23·0	–	60·0	–	–	–	–	23·0	3·2	–	trace	–	Chl. 0·8		12·8	60·0	–	
	0·7	Calc. 0·9	97·4	–	–	–	0·8	–	–	–	–	–	–	–	–	0·7	–	–	–	–	–	Calc. 0·9	97·4	–	0·8	–	–c
	–	Mag. 0·3	96·1	0·2	–	–	0·3	–	–	0·9	–	1·2	–	1·0?	–	–	0·9	0·2	?	–	–	Mag. 0·3	96·1	–	1·5	–	
	–	Mag. 1·4	95·8	0·5	–	–	1·0	–	–	0·5	–	0·6	–	0·2	–	–	0·5	0·5	?	–	–	Mag. 1·4	95·8	–	1·6	–	
1	–	–	–	–	–	Nitric 52·9	–	–	–	–	–	–	–	–	47·1	–	–	–	–	–	–	–	–	Nitric 52·9	–	–	–d
9	–	–	40·6	–	–	Nitric 31·2	–	–	–	–	–	–	–	–	27·9	–	0·3				–	–	40·6	Nitric 31·2	–	–	
5	–	–	–	–	–	–	45·5	–	–	–	–	–	–	–	54·5	–	–	–	–	–	–	–	–	–	45·5	–	
5	–	–	–	–	–	–	–	31·5	–	–	–	–	–	–	68·5	–	–	–	–	–	–	–	–	–	–	31·5	
	37·2	–	–	–	–	Nitric 62·8	–	–	–	–	–	–	–	–	–	37·2	–	–	–	–	–	–	–	Nitric 62·8	–	–	
	33·0	–	9·2	–	–	Nitric 56·3	–	–	–	–	–	–	–	–	–	33·0	1·5				–	–	9·2	Nitric 56·3	–	–	
	44·5	–	–	–	–	–	55·5	–	–	–	–	–	–	–	–	44·5	–	–	–	–	–	–	–	–	55·5	–	
	59·3	–	–	–	–	–	–	40·7	–	–	–	–	–	–	–	59·3	–	–	–	–	–	–	–	–	–	40·7	
	–	–	–	–	–	–	–	–	–	41·1	–	58·9	–	–	–	–	41·1	–	–	–	–	–	–	–	58·9	–	
	–	–	–	33·3	–	–	66·7	–	–	–	–	–	–	–	–	–	–	33·3	–	–	–	–	–	–	66·7	–	
	–	–	–	–	–	–	53·3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	53·3	–	–e
	–	Mur. Acid 68·5		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Mur. Acid 68·5		–	–	–	
	–	–	–	–	–	–	–	56·0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56·0	–f

…deficiency here of 12 per cent.; but Dr. Hodges only professed to give the amount of those ingredients that were useful to …crystallization, and is not affected by merely drying. The ash is calculated in this table after the salt has been exposed …therefore their compositions are only given in their natural state.——*f*. This is a sesqui-carbonate.

F 1.—SPECIAL MANURES, &c.

F 1.—SPECIAL MANURES, &c.

COMPOSITION OF EACH PORTION PER CENT.

Class.	Species.	Variety.		General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Matter or Ash. Authority.	Number of Analyses.	Total Sulphur.
Charcoal.	Animal	— —	—	Phillips .	1	—	88·4	11·6	Phillips	1	89·7	2·4	7·3	0·6	0·7	—	Phillips .	1	—
	Peat .	— —	—	Sir R. Kane	1	—	95·8	4·2	Sir R. Kane	1	93·8	1·8	4·4		?	—	— —	—	—
	Wood .	— —	—	—	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—	—
Ashes.	Wood .	Farnham	—	Nesbit .	1	—	0·4	99·6	— —	—	—	—	—	—	—	—	Nesbit .	1	—
	Peat .	Dutch .	—	Richardson	1	—	32·5	67·5	— —	—	—	—	—	—	—	—	Richardson	1	—
		Farnham	—	Nesbit .	1	—	17·0	83·0	— —	—	—	—	—	—	—	—	Nesbit .	1	—
	Coal .	Dunfermline	—	Johnston	3	—	—	100·0	— —	—	—	—	—	—	—	—	Johnston	3	—
	Sea-weed (kelp).	Tangle .	—	Hodges .	2	—	66·0	34·0	— —	—	—	—	—	—	—	—	Hodges .	1	—
		Kelp .	—	Hodges .	1	—	—	100·0	— —	—	—	—	—	—	—	—	Hodges .	1	—
Bones.	Fresh	— —	—	Anderson	3	—	45·9	54·1	Johnston	1	50·4	6·3	25·4	17·9	21·7	—	Johnston	1	—
		— —	—	Thomson	2	—	45·9	54·1	— —	—	—	—	—	—	—	—	Thomson	2	—
	Bones and Sulph. Acid.	Unburnt	—	Richardson	1	—	25·0	75·0	Richardson	1	47·9	9·4	21·9	20·8	25·2	—	Richardson	1	—
		Burnt .	—	Richardson	1	—	—	100·0	— —	—	—	—	—	—	—	—	Richardson	1	—
Salts.	Chl. of Sodium Common Salts.	Cheshire.	—	Johnston	1	—	—	100·	— —	—	—	—	—	—	—	—	Johnston	1	—
		Bay . .	—	Henry .	3	—	—	100·	— —	—	—	—	—	—	—	—	Henry .	3	—
		Sea, Br. .	—	Henry .	4	—	—	100·	— —	—	—	—	—	—	—	—	Henry .	4	—
	Potash	Nitrate, Saltpetre	—	Parkes .	1	—	—	100·	— —	—	—	—	—	—	—	—	Parkes .	1	—
			—	Wilson .	1	—	—	100·	— —	—	—	—	—	—	—	—	Wilson .	1	—
		Sulphate	—	Parkes .	1	—	—	100·	— —	—	—	—	—	—	—	—	Parkes .	1	—
		Carbona., Pearlash	—	Parkes .	1	20·5	—	79·5	— —	—	—	—	—	—	—	—	Brande .	1	—
	Soda .	Nitrate, Cubic Nitre .	—	Brande .	1	—	—	100·	— —	—	—	—	—	—	—	—	Brande .	1	—
			—	Wilson .	1	—	—	100·	— —	—	—	—	—	—	—	—	Wilson .	1	—
		Sulphate, Glauber Salts.	—	Brande .	1	55·6	—	44·4	— —	—	—	—	—	—	—	—	Brande .	1	—
		Carbonate	—	Brande .	1	62·5	—	37·5	— —	—	—	—	—	—	—	—	Brande .	1	—
	Lime	Sulphate, Gypsum	—	Brande .	1	21·0	—	79·0	— —	—	—	—	—	—	—	—	Brande .	1	—
	Magnesia.	Sulphate, Epsom Salts.	—	Brande .	1	51·2	—	48·8	— —	—	—	—	—	—	—	—	Brande .	1	—
	Ammonia.	Sulphate	—	Brande .	1	24·0	—	76·0	Brande .	—	—	—	—	19·8	22·7	—	Brande .	1	—
		Muriate, Sal Ammoniac.	—	Brande .	1	—	—	100·	Brande .	1	—	—	—	26·0	31·5	—	Brande .	1	—
		Carbona., Smelling Salts.	—	R. Phillips	1	15·2	—	84·8	R. Phillips	1	—	—	—	23·6	28·6	—	R. Phillips	1	—

Inorganic Matter or Ash (continued).

Species.	Variety.	Soluble in Rain-Water. Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia.	Sulph. Acid.	Carbonic Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
Charcoal, Animal	— —	7·1	—	—	22·4	—	—	—	—	—	?	14·4		7·5	7·2	21·1	6·5	—	14·1	—	with sand	14·7	—	—	22·4	3·0	7·5	7·2	
Peat	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Wood	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Ashes, Wood	Farnham	7·6	4·0	—	0·8	?	?	?	3·3	?	?	29·1	6·6	?	23·3	14·3	7·6	4·0	29·1	6·6	0·2	1·5	trace	—	0·8	6·0	3·3	25·3	a
Peat	Dutch	trace	2·5	Chl. 0·7		—	—	?	?	?	?	20·0	trace	17·0	4·1	53·0	trace	2·5	20·0	trace	—	—	—	Chl. 0·7		·7	17·0	4·1	
	Farnham	—	—	0·7	0·5		—	?	—	—	?	6·4	0·1	3·9	3·0	62·2	—	—	6·4	0·1	5·1	10·3	—	0·7	6·5	0·7	3·9	3·0	
Coal	Dunfermline	1·2 ?		—	—	—	—	?	?	?	?	13·6	1·7	2·5	9·6	46·5	1·2		13·6	1·7	6·9	[illegible]		—	—	[illegible]	2·5	9·6	
Sea-weed (kelp)	Tangle	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2·7	8·2	23·8	5·2	6·5	—		—	Chl. 11·7		5·4	20·2	?	b
	Kelp	8·2	23·8	Chl. 11·7		?	—	?	?	?	?	5·2	6·5	20·2	?	2·7	8·2	23·8	5·2	6·5	—	?		Chl. 11·7		5·4	20·2	?	
Bones, Fresh	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5·2	39·7	1·6	—	—	—	Chl. [illegible]		49·5	—	2·4	
	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·2	1·4	41·7	1·1	—	—	—	[illegible]		49·6	—	2·1	
Bones and Sulph. Acid	Unburnt	—	—	—	—	—	—	22·4	?	—	—	24·0	—	47·8	—	—	—	—	24·[illegible]	1·6	—	trace	—	Chl. 4·7		22·4	47·8	—	
	Burnt	—	—	—	—	—	—	12·8	?	—	—	23·0	—	60·6	—	—	—	—	23·0	1·2	—	trace	—	Chl. 0·8		12·8	60·0	—	
Chl. of Sodium Common Salts	Cheshire	—	0·7	Calc. 0·9	97·4	—	—	—	0·8	—	—	—	—	—	—	—	—	0·7	—	—	—	—	—	Calc. 0·9	97·4	—	1·8	—	c
	Bay	—	—	Mag. 0·3	96·1	0·2	—	—	0·3	—	—	1·9	—	1·2	—	1·07	—	—	0·9	0·2	?	—	—	Mag. 0·3	96·1	—	1·[illegible]	—	
	Sea, Br.	—	—	Mag. 1·4	95·8	0·5	—	—	1·0	—	—	0·5	—	0·6	—	0·2	—	—	0·5	0·5	?	—	—	Mag. 1·4	95·8	—	1·6	—	
Potash	Nitrate, Saltpetre	47·1	—	—	—	—	—	Nitric 52·9	—	—	—	—	—	—	—	—	47·1	—	—	—	—	—	—	—	—	Nitric 52·9	—	—	d
		37·9	—	—	40·6	—	—	Nitric 31·2	—	—	—	—	—	—	—	—	37·9	—	0·3				—	—	40·6	Nitric 31·2	—	—	
	Sulphate	54·5	—	—	—	—	—	—	45·5	—	—	—	—	—	—	—	54·5	—	—	—	—	—	—	—	—		45·5	—	
	Carbona., Pearlash	68·5	—	—		—	—	—	—	31·5	—	—	—	—	—	—	68·5	—	—	—	—	—	—	—	—		—	31·5	
Soda	Nitrate, Cubic Nitre	—	37·2	—	—	—	—	Nitric 62·8	—	—	—	—	—	—	—	—	—	37·2	—	—	—	—	—	—	—	Nitric 62·8	—	—	
		—	33·0	—	9·2	—	—	Nitric 56·3	—	—	—	—	—	—	—	—	—	33·0	1·5				—	—	9·2	Nitric 56·3	—	—	
	Sulphate, Glauber Salts	—	44·5	—	—	—	—	—	55·5	—	—	—	—	—	—	—	—	44·5	—	—	—	—	—	—	—	—	55·5	—	
	Carbonate	—	59·3	—	—	—	—	—		40·7	—	—	—	—	—	—	—	59·3	—	—	—		—	—	—	—	—	40·7	
Lime	Sulphate, Gypsum	—	—	—	—	—	—	—	—	—	—	41·1	—	58·9	—	—	—	—	41·1	—	—	—	—	—	—	—	58·9	—	
Magnesia	Sulphate, Epsom Salts	—	—	—	—	33·3	—	—	66·7	—	—	—	—	—	—	—	—	—	—	33·3	—	—	—	—	—	—	66·7	—	
Ammonia	Sulphate	—	—	—	—	—	—	—	53·3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	53·3		e
	Muriate, Sal Ammoniac	—	—	Mur. Acid 68·5		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mur. Acid 68·5		—	—	—	
	Carbona., Smelling Salts	—	—	—	—	—	—	—	—	56·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	56·0	f

a The solubility of these salts is only conjectural, the analysis not having stated their relative solubility.—*b*. There is a deficiency here of 12 per cent; but Dr. Hodges only professed to give the amount of those ingredients that were useful to farmers.—*c*. Refined rock salt.—*d*. The amount of water said to be contained in some of these salts is in a state of crystallization, and is not affected by merely drying. The ash is calculated in this table after the salt has been exposed to a red heat, whereby the water of crystallization is expelled.—*e*. The salts of ammonia are decomposed by heat, and therefore the compositions are only given in their natural state.—*f*. This is a sesqui-carbonate.

F 2.—SPECIAL MANURES.

Class.	Species.			General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSIT[ION]. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorg[anic]. Authority.	Number of Analyses.
Charcoal.	Animal	— —	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
	Peat .	— —	—	Phillips .	1	—	88·4	11·6	Phillips .	1	79·3	2·2	6·4	0·5	0·6	—	Phillips .	1
		— —	—	Sir R. Kane	1	—	95·8	4·2	Sir R. Kane	1	89·9	1·7	4·2		?	—	— —	—
	Wood .	— —	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—
Ashes.	Wood .	Farnham	—	Nesbit .	1	—	0·4	99·6	— —	—	—	—	—	—	—	—	Nesbit .	1
	Peat .	Dutch .	—	Richardson	1	?	32·5	67·5	— —	—	—	—	—	—	—	—	Richardson	1
		Farnham	—	Nesbit .	1	—	17·0	83·0	— —	—	—	—	—	—	—	—	Nesbit .	1
	Coal .	Dunfermline	—	Johnston	3	—	—	100·0	— —	—	—	—	—	—	—	—	Johnston	3
	Sea-weed (Kelp).	Tangle .	—	Hodges .	2	83·8	10·7	5·5	— —	—	—	—	—	—	—	—	Hodges .	1
		Kelp .	—	Hodges .	1	?	?	100·0	— —	—	—	—	—	—	—	—	Hodges .	1
Bones.	Fresh.	— —	—	Anderson	3	11·8	40·5	47·7	Johnston	1	20·4	2·5	10·3	7·3	8·8	—	Johnston	1
		— —	—	Thomson	2	12·0	40·4	47·6	— —	—	—	—	—	—	—	—	Thomson	2
	With Sulph. Acid.	Unburnt	—	Richardson	1	23·3	19·2	57·5	Richardson	1	9·2	1·8	4·2	4·0	4·8	—	Richardson	1
		Burnt .	—	Richardson	1	24·8	—	75·2	— —	—	—	—	—	—	—	—	Richardson	1
Salts.	Chl. of Sodium (Common Salt).	Cheshire	—	Johnston	1	0·1	—	99·9	— —	—	—	—	—	—	—	—	Johnston	1
		Bay . .	—	Henry .	3	?	—	100·0	— —	—	—	—	—	—	—	—	Henry .	3
		Sea, Br. .	—	Henry .	4	?	—	100·0	— —	—	—	—	—	—	—	—	Henry .	4
	Potash	Nitrate, Saltpetre	—	Parkes .	1	—	—	100	— —	—	—	—	—	—	—	—	Parkes .	1
			—	Wilson .	1	4	—	96	— —	—	—	—	—	—	—	—	Wilson .	1
		Sulphate.	—	Parkes .	1	—	—	100	— —	—	—	—	—	—	—	—	Parkes .	1
		Carbona., Pearlash	—	Parkes .	1	20·5	—	79·5	— —	—	—	—	—	—	—	—	Brande .	1
	Soda .	Nitrate, Cubic Nitre	—	Brande .	1	—	—	100	— —	—	—	—	—	—	—	—	Brande .	1
			—	Wilson .	1	10	—	90	— —	—	—	—	—	—	—	—	Wilson .	1
		Sulphate, Glauber Salts.	—	Brande .	1	55·6	—	44·4	— —	—	—	—	—	—	—	—	Brande .	1
		Carbonate	—	Brande .	1	62·5	—	37·5	— —	—	—	—	—	—	—	—	Brande .	1
	Lime .	Sulphate, Gypsum	—	Brande .	1	21·0	—	79·0	— —	—	—	—	—	—	—	—	Brande .	1
	Magnesia.	Sulphate, Epsom Salts.	—	Brande .	1	51·2	—	48·8	— —	—	—	—	—	—	—	—	Brande .	1
	Ammonia.	Sulphate.	—	Brande .	1	24·0	—	76·0	Brande .	1	—	—	—	18·8	22·7	—	Brande .	1
		Muriate, Sal Ammoniac.	—	Brande .	1	—	—	100	Brande .	1	—	—	—	26·0	31·5	—	Brande .	1
		Carbona., Smelling Salts .	—	R. Phillips	1	15·2	—	84·8	R. Phillips	1	—	—	—	23·8	28·8	—	R. Phillips	1

a. Common coal ashes always contain a large quantity of organic matter, on account of not being completely burnt, which
Dr. Wilson are the actual composition of some salts as sold for manure, supposed to be genuine, and with which some
practically would be above the average.——*g.* This salt has a tendency to dry in the air. ——*h.* Ditto.——*i.* This is unburnt ;

F 2.—SPECIAL MANURES.

R CENT.																											
tter or Ash.																											
Soluble in Rain Water.														Total Inorganic Matter.													
Abundantly.									Sparingly.																		
Potash.	Soda.	Chl. of Potass.	Chl. of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carb. Acid.	Silica.	Lime.	Magnesia.	Sulph. Acid.	Carb. Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
?	–	–	2·60	–	–	–	–	–	?	1·67	–	0·87	0·84	2·80	0·75	–	1·67	–	with Sand	1·71	–	–	2·60	0·34	0·87	0·84	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
·6	4·9	–	0·8	?	?	?	3·3	?	?	29·1	6·6	?	25·3	14·3	7·6	4·9	29·1	6·6	0·2	1·5	trace	–	0·8	6·0	3·3	25·3	
ace	1·7	Chl. 0·5		–	–	?	?	?	?	14·1	trace	11·5	2·8	35·8	trace	1·7	14·1	trace	–	–	–	Chl. 0·5		1·1	11·5	2·8	
–	–	0·6	0·4	–	–	?	–	–	?	5·3	0·08	3·2	2·5	51·6	–	–	5·3	0·08	4·4	13·5	–	0·6	0·4	0·6	3·2	2·5	
1·2		–	–	–	–	?	?	?	?	13·6	1·7	2·5	9·6	48·5	1·2		13·6	1·7	6·9	13·5	–	–	–	0·9	2·5	9·6	-a
–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·15	0·45	1·42	0·29	0·47	–	–	–	Chl. 0·64		0·30	1·11	?	
20	25·80	Chl. 11·70		?	–	?	?	?	?	5·20	8·50	20·2	?	2·70	8·20	25·80	5·20	8·50	–	–	–	Chl. 11·70		5·40	20·20	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2·48	18·94	0·76	–	–	–	Chl. 0·48		23·61	–	1·14	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·10	0·19	19·85	0·52	–	–	–	–	?	23·70	–	1·09	
–	–	–	–	–	–	12·9	–	–	–	13·8	–	27·5	–	–	–	–	13·80	0·60	–	trace	–	Chl. 2·7 ?		12·9	27·5	–	
–	–	–	–	–	–	9·6	–	–		17·3	–	45·1	–	–	–	–	17·3	2·4	–	trace	–	Chl. 0·6		9·6	45·1	–	
–	0·7	Cal. 0·9	97·4	–	–	–	0·8	–	–	–	–	–	–	–	–	0·7	–	–	–	–	–	Cal. 0·9	97·4	–	0·8	–	-b
–	–	Mag. 0·3	96·1	0·2	–	–	0·3	–	–	0·9	–	1·2	–	1·0?	–	–	0·9	0·2	?	–	–	Mag. 0·3	96·1	–	1·5	–	-c
–	–	Mag. 1·4	95·8	0·5	–	–	1·0	–	–	0·5	–	0·6	–	0·2?	–	–	0·5	0·5	?	–	–	Mag. 1·4	95·8	–	1·6	–	-d
7·1	–	–	–	–	–	Nitr. 52·9	–	–	–	–	–	–	–	–	47·1	–	–	–	–	–	–	–	–	Nitr. 52·9	–	–	
6·8	–	–	39·0	–	–	Nitr. 29·9	–	–	–	–	–	–	–	–	26·8	–	–		0·3		–	–	39·0	Nitr. 29·9	–	–	-e
4·5	–	–	–	–	–	–	45·5	–	–	–	–	–	–	–	54·5	–	–	–	–	–	–	–	–	–	45·5	–	
4·5	–	–	–	–	–	–	–	25·0	–	–	–	–	–	–	54·5	–	–	–	–	–	–	–	–	–	–	25·0	-f
–	37·2	–	–	–	–	Nitr. 62·2	–	–	–	–	–	–	–	–	–	37·2	–	–	–	–	–	–	–	Nitr. 62·8	–	–	
–	29·7	–	8·3	–	–	Nitr. 50·7	–	–	–	–	–	–	–	–	–	29·7		1·3		–	–	–	8·3	Nitr. 50·7	–	–	
–	19·8	–	–	–	–	–	24·6	–	–	–	–	–	–	–	–	19·8	–	–	–	–	–	–	–	–	24·6	–	-g
–	22·3	–	–	–	–	–	–	15·2	–	–	–	–	–	–	–	22·3	–	–	–	–	–	–	–	–	–	15·2	-h
–	–	–	–	–	–	–	–	–	–	32·5	–	46·5	–	–	–	–	32·5	–	–	–	–	–	–	–	46·5	–	-i
–	–	–	–	16·3	–	–	32·5	–	–	–	–	–	–	–	–	–	–	16·3	–	–	–	–	–	–	32·5	–	
–	–	–	–	–	–	–	53·3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	53·3	–	-k
–	Mur. Acid 68·5		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Mur. Acid 68·5		–	–	–	
–	–	–	–	–	–	–	–	56·0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56·0	

of course must be allowed for.——*b.* Refined rock-salt.——*c.* Foreign sea-salt.——*d.* British sea-salt.——*e.* The analyses by experiments were tried.——*f.* This salt attracts the moisture from the air in large quantities, and therefore these quantities if burnt, see the inorganic analysis in the first part of this table.——*h.* Attracts moisture.

F 2.—SPECIAL MANURES.

F 2.—SPECIAL MANURES.

General Division. ENTIRE COMPOSITION PER CENT.

Class	Species			In Natural State: Authority	Number of Analyses	Water	Organic Matter	Ash	Organic Matter, Ultimate Elements: Authority	Number of Analyses	Carbon	Hydrogen	Oxygen	Nitrogen	Ammonia	Sol. Organic Matter	Inorganic Matter or Ash: Authority	Number of Analyses	Total Sulphur
Charcoal	Animal	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	– –	–	–
	Peat	– –	–	Phillips	1	–	88·4	11·6	Phillips	1	79·3	3·2	6·4	0·5	0·6	–	Phillips	1	–
		– –	–	Sir R. Kane	1	–	95·8	4·2	Sir R. Kane	1	95·9	1·5	4·2		?	–	– –	–	–
	Wood	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–	–
Ashes	Wood	Farnham	–	Nesbit	1	–	0·4	99·6	– –	–	–	–	–	–	–	–	Nesbit	1	–
	Peat	Dutch	–	Richardson	1	?	32·5	67·5	– –	–	–	–	–	–	–	–	Richardson	1	–
		Farnham	–	Nesbit	1	–	17·0	83·0	– –	–	–	–	–	–	–	–	Nesbit	1	–
	Coal	Dunfermline	–	Johnston	3	–	–	100·0	– –	–	–	–	–	–	–	–	Johnston	3	–
	Sea-weed Kelp	Tangle	–	Hodges	2	83·8	10·7	5·5	– –	–	–	–	–	–	–	–	Hodges	1	–
		Kelp	–	Hodges	1	?	?	100·0	– –	–	–	–	–	–	–	–	Hodges	1	–
Bones	Fresh	– –	–	Anderson	3	11·8	40·5	47·7	Johnston	1	20·4	2·5	10·3	7·3	8·8	–	Johnston	1	–
		– –	–	Thomson	2	12·0	40·4	47·6	– –	–	–	–	–	–	–	–	Thomson	2	–
	With Sulph. Acid	Unburnt	–	Richardson	1	23·3	19·2	57·5	Richardson	1	9·2	1·8	4·2	4·0	4·8	–	Richardson	1	–
		Burnt	–	Richardson	1	24·8	–	75·2	– –	–	–	–	–	–	–	–	Richardson	1	–
Salts	Chl. of Sodium (Common Salt)	Cheshire	–	Johnston	1	0·1	–	99·9	– –	–	–	–	–	–	–	–	Johnston	1	–
		Bay	–	Henry	3	?	–	100·0	– –	–	–	–	–	–	–	–	Henry	3	–
		Sea, Br.	–	Henry	4	?	–	100·0	– –	–	–	–	–	–	–	–	Henry	4	–
	Potash	Nitrate, Saltpetre	–	Parkes	1	–	–	100	– –	–	–	–	–	–	–	–	Parkes	1	–
			–	Wilson	1	4	–	96	– –	–	–	–	–	–	–	–	Wilson	1	–
		Sulphate	–	Parkes	1	–	–	100	– –	–	–	–	–	–	–	–	Parkes	1	–
		Carbonate, Pearlash	–	Parkes	1	20·5	–	79·5	– –	–	–	–	–	–	–	–	Brande	1	–
	Soda	Nitrate, Cubic Nitre	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
			–	Wilson	1	10	–	90	– –	–	–	–	–	–	–	–	Wilson	1	–
		Sulphate, Glauber Salts	–	Brande	1	55·6	–	44·4	– –	–	–	–	–	–	–	–	Brande	1	–
		Carbonate	–	Brande	1	62·5	–	37·5	– –	–	–	–	–	–	–	–	Brande	1	–
	Lime	Sulphate, Gypsum	–	Brande	1	21·0	–	79·0	– –	–	–	–	–	–	–	–	Brande	1	–
	Magnesia	Sulphate, Epsom Salts	–	Brande	1	51·2	–	48·8	– –	–	–	–	–	–	–	–	Brande	1	–
	Ammonia	Sulphate	–	Brande	1	24·0	–	76·0	Brande	1	–	–	–	18·4	22·7	–	Brande	1	–
		Muriate, Sal Ammoniac	–	Brande	1	–	–	100	Brande	1	–	–	–	26·0	31·5	–	Brande	1	–
		Carbonate, Smelling Salts	–	R. Phillips	1	15·2	–	84·8	R. Phillips	1	–	–	–	23·8	24·8	–	R. Phillips	1	–

Inorganic Matter or Ash (continued).

Class	Species		Soluble in Rain Water, Abundantly: Potash	Soda	Chl. of Potass.	Chl. of Sodium	Magnesia	Iron	Phos. Acid	Sulph. Acid	Carb. Acid	Sparingly: Silica	Lime	Magnesia	Sulph. Acid	Carb. Acid	Total Inorganic Matter: Sand and Silica	Potash	Soda	Lime	Magnesia	Alumina	Oxide of Iron	Oxide of Manganese	Chloride of Potassium	Chloride of Sodium	Phosphoric Acid	Sulphuric Acid	Carbonic Acid	
Charcoal	Animal	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	Peat	– –	·	–	–	2·9	–	–	–	–	–	?	1·67	–	0·97	0·84	2·80	0·75	–	1·67	–	with Sand	1·71	–	–	2·60	0·31	0·67	0·84	
		– –	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	–	
	Wood	– –	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Ashes	Wood	Farnham	7·6	4·9	–	0·8	?	?	?	3·3	?	?	20·1	6·6	?	25·1	14·3	7·6	4·9	20·1	6·6	0·2	1·5	trace		0·8	6·0	3·3	25·3	
	Peat	Dutch	trace	1·7	Chl. 0·5		–	–	?	?	?	?	14·1	trace	11·5	2·8	35·8	trace	1·7	14·1	trace	–	–	–	Chl. 0·5		1·1	11·5	2·8	
		Farnham	–	–	0·6	0·4	–	–	?	–	–	?	5·3	0·6	3·2	2·5	51·6	–	–	5·3	·58	4·4	13·5	–	0·6	0·4	0·6	1·2	2·5	
	Coal	Dunfermline	1·2		–	–	–	–	?	?	?	?	13·6	1·7	2·5	9·0	19·5	1·2		13·6	1·7	6·0	13·5	–	–	–	0·9	2·5	9·6	a
	Sea-weed Kelp	Tangle	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·15	0·45	·42	0·59	·47	–	–	–	Chl. ·64		0·30	1·31	?	
		Kelp	6·20	25·80	Chl. 11·70		?	–	?	?	?	?	5·20	6·50	20·2	?	0·70	8·25	25·80	5·20	6·50	–	–	–	Chl. 11·70		5·40	20·20	?	
Bones	Fresh	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·?	2·48	18·94	0·76	–	–	–	Chl. 0·48		23·61	–	1·14	
		– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		0·19	19·85	·52	–	–	–	?		23·70	–	1·09	
	With Sulph. Acid	Unburnt	–	–	–	–	–		2·9	–	–	–	13·8	–	27·5	–	–	–	–	11·80	0·60	–	trace	–	Chl. 2·?		12·9	27·5	–	
		Burnt	–	–	–	–	–		9·6	–	–		17·3	–	45·1	–	–	–	–	17·7	·4	–	trace	–	Chl. ·6		9·6	45·1	–	
Salts	Chl. of Sodium (Common Salt)	Cheshire	–	0·7	Cal. 0·3	97·4	–		–	0·6	–	–	–	–	–		–	–	0·7	–	–	–	–	–	Cal. 0·3	97·4	–	0·6	–	b
		Bay	–	–	Mag. 0·3	96·1	0·2		–	0·3	–		0·5	–	1·2	–	1·02	–	–	0·9	0·2	?	–	–	Mag. 0·3	96·1	–	1·5	–	c
		Sea, Br.	–	–	Mag. 1·4	95·8	0·5	–	–	1·0	–	–	0·5	–	0·6	–	0·2	–	–	0·5	0·5	?	–	–	Mag. 1·4	95·8	–	1·6	–	d
	Potash	Nitrate, Saltpetre	47·1	–	–	–	–		Nitr. 52·9	–	–	–	–	–	–	–	–	47·1	–	–	–	–	–	–	–	–	Nitr. 52·9	–	–	
			26·8	–	–	39·1	–		Nitr. 29·9	–	–	–	–	–	–	–	–	26·8	–	–	–	0·3	–	–	39·0		Nitr. 29·9		–	e
		Sulphate	54·5	–	–	–	–		–	45·5	–	–	–	–	–	–	–	54·5	–	–	–	–	–	–	–	–	–	45·5	–	
		Carbonate, Pearlash	51·5	–	–	–	–		–	–	25·0	–	–	–	–	–	–	51·5	–	–	–	–	–	–	–	–	–	–	25·0	f
	Soda	Nitrate, Cubic Nitre	–	37·2	–	–	–		Nitr. 62·8	–	–	–	–	–	–	–	–	–	37·2	–	–	–	–	–	–	–	Nitr. 62·8	–	–	
			–	29·7	–	8·3	–		Nitr. 50·7	–	–		–	–	–	–	–	–	29·7		1·1		–	–	–	8·3	Nitr. 50·7	–	–	
		Sulphate, Glauber Salts	–	19·8	–	–	–	–	–	24·6	–		–	–	–	–	–	–	19·8	–	–	–	–	–	–	–	–	24·6	–	g
		Carbonate	–	22·3	–	–	–		–	–	15·2	–	–	–	–	–	–	–	22·3	–	–	–	–	–	–	–	–	–	15·2	h
	Lime	Sulphate, Gypsum	–	–	–	–	–		–	–	–	–	32·5	–	46·5	–	–	–	–	32·5	–	–	–	–	–	–	–	46·5	–	i
	Magnesia	Sulphate, Epsom Salts	–	–	–	–	16·3	–	–	32·5	–	–	–	–	–	–	–	–	–	–	16·3	–	–	–	–	–	–	32·5	–	
	Ammonia	Sulphate	–	–	–	–	–	–	–	53·3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	53·3	–	k
		Muriate, Sal Ammoniac	–	Mur. Acid 68·5		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Mur. Acid 68·5		–	–	–	
		Carbonate, Smelling Salts	–	–	–	–	–	–	–	–	56·0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56·0	

a. Common coal ashes always contain a large quantity of organic matter, on account of not being completely burnt, which of course must be allowed for.——*b.* Refined rock-salt.——*c.* Foreign sea-salt.——*d.* British sea-salt.——*e.* The analyses by Dr. Wilson are the actual composition of some salts as sold for manure, supposed to be genuine, and with which some experiments were tried.——*f.* This salt attracts the moisture from the air in large quantities, and therefore these quantities practically would be above the average.——*g.* This salt has a tendency to dry in the air.——*h.* Ditto.——*i.* This is unburnt; if burnt, see the inorganic analysis in the first part of this table.——*k.* Attracts moisture.

F 3.—SPECIAL MANURES, &c.

Class.	Species.			General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Authority.	Number of Analyses.	Total Sulphur.
Charcoal.	Animal	— —	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—	—
	Peat	— —	—	Phillips .	1	—	1980	260	Phillips .	1	1777	49	143	11	13	—	Phillips .	1	—
		— —	—	Sir R.Kane	1	—	2146	94	Sir R.Kane	1	2014	38	94		?	—	— —	—	—
	Wood .	— —	—	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—	—
Ashes.	Wood .	Farnham	—	Nesbit .	1	?	9	2231	— —	—	—	—	—	—	—	—	Nesbit .	1	—
	Peat .	Dutch .	—	Richardson	1	?	728	1512	— —	—	—	—	—	—	—	—	Richardson	1	—
		Farnham	—	Nesbit .	1	?	381	1859	— —	—	—	—	—	—	—	—	Nesbit .	1	—
	Coal .	Dunferline	—	Johnston	3	?	?	2240	— —	—	—	—	—	—	—	—	Johnston	3	—
	Sea-weed (Kelp).	Tangle .	—	Hodges .	2	1877	240	123	— —	—	—	—	—	—	—	—	Hodges .	1	—
		Kelp . .	—	Hodges .	1	?	?	2240	— —	—	—	—	—	—	—	—	Hodges .	1	—
Bones.	Fresh	— —	—	Anderson	3	264	907	1069	Johnston	1	457	56	231	163	197	—	Johnston	1	—
		— —	—	Thomson	2	269	905	1066	— —	—	—	—	—	—	—	—	Thomson	2	—
	With Sulph. Acid.	Unburnt	—	Richardson	1	522	430	1288	Richardson	1	206	40	94	90	109	—	Richardson	1	—
		Burnt .	—	Richardson	1	556	—	1684	— —	—	—	—	—	—	—	—	Richardson	1	—
Salts.	Chl. Sodium (Common Salt).	Cheshire	—	Johnston	1	2	—	2238	— —	—	—	—	—	—	—	—	Johnston	1	—
		Bay . .	—	Henry .	3	?	—	2240	— —	—	—	—	—	—	—	—	Henry .	3	—
		Sea, Eng.	—	Henry .	4	?	—	2240	— —	—	—	—	—	—	—	—	Henry .	4	—
	Potash	Nitrate, Saltpetre	—	Parkes .	1	—	—	2240	— —	—	—	—	—	—	—	—	Parkes .	1	—
			—	Wilson .	1	90	—	2150	— —	—	—	—	—	—	—	—	Wilson .	1	—
		Sulphate	—	Parkes .	1	—	—	2240	— —	—	—	—	—	—	—	—	Parkes .	1	—
		Carbona., Pearlash	—	Parkes .	1	459	—	1781	— —	—	—	—	—	—	—	—	Brande .	1	—
	Soda	Nitrate, Cubic Nitre .	—	Brande .	1	—	—	2240	— —	—	—	—	—	—	—	—	Brande .	1	—
			—	Wilson .	1	224	—	2016	— —	—	—	—	—	—	—	—	Wilson .	1	—
		Sulphate, Glauber Salts.	—	Brande .	1	1245	—	995	— —	—	—	—	—	—	—	—	Brande .	1	—
		Carbonate	—	Brande .	1	1400	—	840	— —	—	—	—	—	—	—	—	Brande .	1	—
	Lime	Sulphate, Gypsum	—	Brande .	1	470	—	1770	— —	—	—	—	—	—	—	—	Brande .	1	—
	Magnesia.	Sulphate, Epsom Salts.	—	Brande .	1	1147	—	1093	— —	—	—	—	—	—	—	—	Brande .	1	—
	Ammonia.	Sulphate	—	Brande .	1	538	—	1702	Brande .	1	—	—	—	421	508	—	Brande .	1	—
		Muriate. Sal Ammoniac	—	Brande .	1	—	—	2240	Brande .	1	—	—	—	582	709	—	Brande .	1	—
		Carbona., Smelling Salts.	—	R. Phillips	1	340	—	1900	R.Phillips	1	—	—	—	533	645	—	R. Phillips	1	—

a. See note *a*, p. 492.——*b.* The magnesia probably is combined with sulphuric acid, and therefore very soluble; but as
c. For remarks on these

F 3.—SPECIAL MANURES, &c.

PER TON, IN POUNDS.

Matter or Ash.

Soluble in Rain Water. Abundantly.									Soluble in Rain Water. Sparingly.					Total Inorganic Matter.													
Potash.	Soda.	Chloride Potass.	Chloride Sodium.	Magnesia	Iron.	Phosph. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	63	17	–	38	–	wth sand	38	–	–	58	8	19	19	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
170	110	–	18	?	?	?	74	?	?	652	148	?	567	320	170	110	652	148	4	34	trace	–	18	134	74	567	
trace	38	Chl. 11		–	–	?	?	?	?	316	trace	258	63	802	trace	38	316	trace	–	–	–	Chl. 11		25	258	63	
–	–	14	9	–	–	?	–	–	?	119	2	72	56	1156	–	–	119	2	99	302	–	14	9	14	72	56	
27		–	–	–	–	?	?	?	?	305	38	56	215	1086	27		305	38	155	302	–	–	–	20	56	215	–*a*
–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	10	32	7	11	–	?	?	Chl. 14		7	25	?	
184	57	8	Chl. 262	?	–	?	?	?	?	117	190	453	?	61	184	578	117	190	–	?	?	Chl. 262		121	453	?	–*b*
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56	424	13	–	–	–	Chl. 11		529	–	26	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	4	445	12	–	–	–	–	?	531	–	25	
–	–	–	–	–	–	289	?	–	–	309	–	392	–	–	–	–	309	14	–	trace	–	Chl. 61		289	615	?	
–	–	–	–	–	–	215	?	–	–	388	–	1010	–	–	–	–	388	54	–	trace	–	Chl. 14		215	1010	–	
–	16	calc. 20	2182	–	–	–	18	–	–	–	–	–	–	–	–	16	–	–	–	–	–	calc. 20	2182	–	18	–	
–	–	Mag. 7	2152	5	–	–	7	–	–	20	–	27	–	22	–	–	20	5	?	–	–	Mag. 7	2152	–	34	–	
–	–	Mag. 31	2146	11	–	–	22	–	–	11	–	14	–	5	–	–	11	11	?	–	–	Mag. 31	2146	–	36	–	
1055	–	–	–	–	–	Nitric 1185	–	–	–	–	–	–	–	–	1055	–	–	–	–	–	–	–	–	Nitric 1185	–	–	–*c*
600	–	–	873	–	–	Nitric 670	–	–	–	–	–	–	–	–	600	–	–		7		–	–	873	Nitric 670	–	–	
1221	–	–	–	–	–	–	1019	–	–	–	–	–	–	–	1221	–	–	–	–	–	–	–	–	–	1019	–	
1221	–	–	–	–	–	–	–	560	–	–	–	–	–	–	1221	–	–	–	–	–	–	–	–	–	–	560	
–	833	–	–	–	–	Nitric 1407	–	–	–	–	–	–	–	–	–	833	–	–	–	–	–	–	–	Nitric 1407	–	–	
–	665	–	186	–	–	Nitric 1136	–	–	–	–	–	–	–	–	–	665	–		29		–	–	186	Nitric 1136	–	–	
–	444	–	–	–	–	–	551	–	–	–	–	–	–	–	–	444	–	–	–	–	–	–	–	–	551	–	
–	500	–	–	–	–	–	–	340	–	–	–	–	–	–	–	500	–	–	–	–	–	–	–	–	–	340	
–	–	–	–	–	–	–	–	–	–	728	–	1042	–	–	–	–	728	–	–	–	–	–	–	–	1042	–	
–	–	–	–	365	–	–	728	–	–	–	–	–	–	–	–	–	–	365	–	–	–	–	–	–	728	–	
–	–	–	–	–	–	–	1194	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1194	–	
–	Mur. acid. 1534		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Mur. acid. 1534		–	–	–	
–	–	–	–	–	–	–	–	1255	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1255	

the salts are not stated in the analysis, I have placed all the doubtful salts under the head of "Sparingly soluble."—— salts, see Note *d*, p. 490.

F 4.—SPECIAL MANURES.

Class.	Species.		Tons.	Cwt.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION PER — Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic — Authority.	Number of Analyses.	Total Sulphur.
Charcoal.	Animal	— —	-	-	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—	—
	Peat	— —	1	-	Phillips .	1	?	1980	260	Phillips .	1	1777	49	143	11	13	—	Phillips .	1	—
	Peat	— —	1	-	Sir R. Kane	1	?	2146	94	Sir R. Kane	1	2014	38	94		?	—	— —	—	—
	Wood .	— —	1	-	— —	—	—	—	—	— —	—	—	—	—	—	—	—	— —	—	—
Ashes.	Wood .	Farnham	-	5	Nesbit .	1	?	2	558	— —	—	—	—	—	—	—	—	Nesbit .	1	—
	Peat	Dutch .	-	5	Richardson	1	?	182	378	— —	—	—	—	—	—	—	—	Richardson	1	—
	Peat	Farnham	-	5	Nesbit .	1	?	95	465	— —	—	—	—	—	—	—	—	Nesbit .	1	—
	Coal .	Dunferline	-	5	Johnston	3	?	?	560	— —	—	—	—	—	—	—	—	Johnston	3	—
	Sea-weed (Kelp).	Tangle	10	-	Hodges .	2	18770	2400	1230	— —	—	—	—	—	—	—	—	Hodges .	1	—
	Sea-weed (Kelp).	Kelp.		10	Hodges .	1	—	—	—	— —	—	—	—	—	—	—	—	Hodges .	1	—
Bones.	Fresh .	— —	-	4	Anderson	3	53	181	214	Johnston	1	91	11	46	33	39	—	Johnston	1	—
	Fresh .	— —	-	4	Thomson	2	54	181	213	— —	—	—	—	—	—	—	—	Thomson	2	—
	With Sulph. Acid.	Unburnt	-	4	Richardson	1	104	86	258	Richardson	1	41	8	19	18	22	—	Richardson	1	—
	With Sulph. Acid.	Burnt .	-	4	Richardson	1	111	—	337	— —	—	—	—	—	—	—	—	Richardson	1	—
Salts.	Chl. of Sodium (Common Salt).	Cheshire	-	3	Johnston	1	—	—	336	— —	—	—	—	—	—	—	—	Johnston	1	—
	Chl. of Sodium (Common Salt).	Bay . .	-	3	Henry .	3	?	—	336	— —	—	—	—	—	—	—	—	Henry .	3	—
	Chl. of Sodium (Common Salt).	Sea, Eng.	-	3	Henry .	4	?	—	336	— —	—	—	—	—	—	—	—	Henry .	4	—
	Potash	Nitrate, Saltpetre	-	1	Parkes .	1	—	—	112	— —	—	—	—	—	—	—	—	Parkes .	1	—
	Potash	Nitrate, Saltpetre	-	1	Wilson .	1	4	—	108	— —	—	—	—	—	—	—	—	Wilson .	1	—
	Potash	Sulphate	-	-	Parkes .	1	—	—	—	— —	—	—	—	—	—	—	—	Parkes .	1	—
	Potash	Carbona., Pearlash	-	2	Parkes .	1	46	—	178	— —	—	—	—	—	—	—	—	Brande .	1	—
	Soda	Nitrate, Cubic Nitre	-	2	Brande .	1	—	—	224	— —	—	—	—	—	—	—	—	Brande .	1	—
	Soda	Nitrate, Cubic Nitre	-	2	Wilson .	1	22	—	202	— —	—	—	—	—	—	—	—	Wilson .	1	—
	Soda	Sulphate, Glauber Salts.	-	2	Brande .	1	125	—	99	— —	—	—	—	—	—	—	—	Brande .	1	—
	Soda	Carbonate	-	2	Brande .	1	140	—	84	— —	—	—	—	—	—	—	—	Brande .	1	—
	Lime	Sulphate, Gypsum	-	5	Brande .	1	118	—	442	— —	—	—	—	—	—	—	—	Brande .	1	—
	Magnesia.	Sulphate, Epsom Salts.	-	3	Brande .	1	172	—	164	— —	—	—	—	—	—	—	—	Brande .	1	—
	Ammonia.	Sulphate	-	2	Brande .	1	54	—	170	Brande .	1	—	—	—	42	51	—	Brande .	1	—
	Ammonia.	Muriate, Sal Ammoniac	-	2	Brande .	1	—	—	224	Brande .	1	—	—	—	58	71	—	Brande .	1	—
	Ammonia.	Carbona., Smelling Salts.	-	-	R. Phillips	1	—	—	—	R. Phillips	1	—	—	—	—	—	—	R. Phillips	1	—

a. The quantities given in this part of the table are of course quite arbitrary, although I have taken the mean of the quantities by the preceding

F 4.—SPECIAL MANURES.

STATUTE ACRE, IN POUNDS.

Matter or Ash.

Soluble in Rain Water.														Total Inorganic Matter.												
Abundantly.									Sparingly.																	
Potash.	Soda.	Chloride of Potass.	Chloride Sodium.	Magnesia.	Iron.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	63	17	–	38	–	with Sand.	38	–	–	58	8	19	19
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
43	28	–	4	?	?	?	19	?	?	163	37	?	142	80	43	28	163	37	1	8	trace	–	4	33	19	142
trace	9	Chlorides 3		–	–	?	?	?	?	79	trace	64	16	201	trace	9	79	trace	–	–	–	Chlorides 3		6	64	16
–	–	4	2	–	–	?	–	–	?	30	1	18	14	289	–	–	30	1	25	76	–	4	2	4	18	14
7		–	–	–	–	?	?	?	?	76	10	14	54	271	7		76	10	39	75	–	–	–	5	14	54
–	–	–	–	–	–	–	–	–	–	–	–	–	–	30	100	320	70	110	–	?	?	Chlorides 140		70	250	?
92	289	Chlorides 131		?	–	?	?	?	?	58	95	227	?	30	92	289	58	95	–	?	?	Chlorides 131		61	227	?
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	85	3	–	–	–	Chlorides 2		106	–	5
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·4	0·8	89	2	–	–	–	?		106	–	5
–	–	–	–	–	–	58	?	–	–	62	–	123	–	–	–	–	62	3	–	trace	–	Chlorides 12		58	123	–
–	–	–	–	–	–	43	?	–	–	78	–	202	–	–	–	–	78	11	–	trace	–	3		43	202	–
–	3	Calc. 3	327	–	–	–	3	–	–	–	–	–	–	–	–	3	–	–	–	–	–	Calc. 3	327	–	3	–
–	–	Mag. 1	323	1	–	–	1	–	–	3	–	4	–	3	–	–	3	1	?	–	–	Mag. 1	323	–	5	–
–	–	Mag. 4	323	2	–	–	3	–	–	2	–	2	–	1	–	–	2	2	?	–	–	4	323	–	5	–
53	–	–	–	–	–	Nitric 59	–	–	–	–	–	–	–	–	53	–	–	–	–	–	–	–	–	Nitric 59	–	–
30	–	–	44	–	–	Nitric 33	–	–	–	–	–	–	–	–	30	–	–		0·3		–	–	44	Nitric 33	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
122	–	–	–	–	–	–	–	56	–	–	–	–	–	–	122	–	–	–	–	–	–	–	–	–	–	56
–	83	–	–	–	–	Nitric 141	–	–	–	–	–	–	–	–	–	83	–	–	–	–	–	–	–	Nitric 141	–	–
–	66	–	18	–	–	Nitric 114	–	–	–	–	–	–	–	–	–	66	–		3		–	–	18	114	–	–
–	44	–	–	–	–	–	55	–	–	–	–	–	–	–	–	44	–	–	–	–	–	–	–	–	55	–
–	50	–	–	–	–	–	–	34	–	–	–	–	–	–	–	50	–	–	–	–	–	–	–	–	–	34
–	–	–	–	–	–	–	–	–	–	182	–	260	–	–	–	–	182	–	–	–	–	–	–	–	260	–
–	–	–	–	55	–	–	109	–	–	–	–	–	–	–	–	–	–	55	–	–	–	–	–	–	109	–
–	–	–	–	–	–	–	119	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	119	–
–	–	Mur. Acid 153		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Mur. Acid. 153		–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

applied per acre in a great number of published experiments; but of course they would be easily corrected to any other amount part of the table.

G 1.—MANURES—MANUFACTURERS', &c., REFUSE.

Class.	Manufacture.	Refuse.			General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF EACH — Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic Authority.	Number of Analyses.
	Soot	House –	–	–	Johnston .	1	–	70·5	29·5	Völcker .	1	–	–	–	1·1	1·3	–	Solly. .	1
		House –	–	–	Johnston .	1	–	74·3	25·7	Völcker .	1	–	–	–	5·4	6·6	–	– –	–
		Laboratory	–	–	Johnston .	1	–	51·5	48·5	Völcker .	1	–	–	–	2·8	3·4	–	– –	–
	Fish	Sprats –	year 1847		Way . .	1	–	94·0	6·0	Way . . .	1	–	–	–	5·8	7·0	–	Way . .	1
		Sprats –	year 1848		Way . .	1	–	94·2	5·8	– –	–	–	–	–	–	–	–	Way . .	1
Vegetable.	Cider –	Apple –	–	–	Boussingault and Payen.	1	–	100?		Boussingault and Payen.	1	–	–	–	0·67	0·81	–	– –	–
	Starch –	Potato –	–	–	Boussingault and Payen.	1	–	100?		Boussingault and Payen.	1	–	–	–	1·95	2·36	–	– –	–
	Sugar –	Beetroot	–	–	Boussingault and Payen.	1	–	100?		Boussingault and Payen.	1	–	–	–	1·26	1·53	–	– –	–
Animal.	Woollen.	Rags –	–	–	Way . .	1	–	89·9	10·1	Way . .	1	–	–	–	11·4	13·8	–	Nesbit .	1
		Prennings	–	–	Way . .	1	–	100?		Way . .	1	–	–	–	10·7	12·9	–	– –	–
		Cuttings	–	–	Way . .	1	–	100?		Way . .	1	–	–	–	13·0	15·7	–	– –	–
		Shoddy –	–	–	Way . .	1	–	100?		Way . .	1	–	–	–	4·9	5·9	–	– –	–
		Wool –	–	–	Way . .	1	–	63·1	36·9	Way . .	1	–	–	–	4·3	5·2	–	Way . .	1
	Glue	Scutch –	–	–	Johnston .	1	–	52·4	47·6	– –	–	–	–	–	–	–	–	Johnston	1
		Scutch –	–	–	Way . .	2	–	30·0	70·0	Way . .	2	–	–	–	5·5	6·7	–	Way . .	2
	Horn –	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Brewers	Spent Hops	–	–	Nesbit . .	1	–	89·6	10·4	Boussingault and Payen.	1	–	–	–	2·2	2·7	–	Nesbit .	1
Mineral.	Soda –	Soda Ash	–	–	Way . .	1	–	–	100	– –	–	–	–	–	–	–	–	Way . .	1
	Carbonate Soda.	Alkali waste.	–	–	Way . .	1	–	–	100	– –	–	–	–	–	–	–	–	Way . .	1
	Bleachers.	Lime Refuse.	–	–	Fromberg .	1	–	18·6	81·4	– –	–	–	–	–	–	–	–	Fromberg	1
	Iron –	Iron Slag	–	–	Cameron .	1	–	–	100	– –	–	–	–	–	–	–	–	Cameron	1
	Soda Water.	Lime Refuse.	–	–	Johnston .	1	–	–	100	– –	–	–	–	–	–	–	–	Johnston	1
	Prussiate Potash.	Refuse –	–	–	Richardson	1	–	–	100	– –	–	–	–	–	–	–	–	Richardson	1
	Patent Alum.	Refuse –	–	–	Richardson	1	–	–	100	– –	–	–	–	–	–	–	–	Richardson	1
	Gas Works.	Lime Refuse.	–	–	Johnston .	2	–	–	100	– –	–	–	–	–	–	–	–	Johnston	2
	Coal Mine.	Waste Heap.	–	–	Anderson .	1	1·75	0·92	97·3	Anderson .	1	–	–	–	trace	trace	–	Anderson	1

a. These two specimens were collected from different parts of the same chimney.——*b*. These analyses are of sprats caught calculated as though the whole were organic matter.——*d*. Sweepings of cloth mills.——*e*. This ought properly to be boiling heat. The heap at Newcastle is composed of the ash of the small mixed with various shales.

G 1.—MANURES—MANUFACTURERS', &c., REFUSE.

PORTION PER CENT.

Matter or Ash.

Total Sulphur.	Soluble in Rain Water. Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	Salts. 11·8		?	?	–	–	–	with Salts.	with Salts.	–	6·3	0·5	9·0	0·5	32·0	Salts. 11·8		6·3	0·5	15·3	24·6	–	?	?	–	9·0	0·5	-a
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	trace	17·2	1·2	23·6	3·0	–	0·3	–	–	11·2	43·5	trace	–	-b
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·3	21·9	–	27·2	3·4	–	0·7	–	2·3	2·3	40·5	1·4	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	16·8	4·1	2·0	15·1	1·5	–	20·0	–	–	11·9	15·6	12·9	?	-c
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-d
–	Salts. 0·3				–	–	–	with Salts.	–	–	15·4	–	–	12·1	61·8	Salts. 0·3		17·3	–	6·1		–	with salts.		2·4	with Salts.	12·1	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11·9	–	–	46·4	1·6	–	–	–	–	–	5·5	–	34·6	
–	–	–	–	–	–	–	–	–	–	–	38·4	?	6·0	26·6	23·2	–	–	39·4	0·[illegible]	2·5		–	–	–	1·3	6·0	26·6	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	48·9	1·5	–	23·7	2·7	–	1·5	trace	0·7	3·6	5·1	3·0	9·6	-e
–	–	45·9	–	13·9	–	–	–	7·9	16·0	–	5·8	–	–	4·5	3·3	–	45·9	5·8	–	–	2·7	–	–	13·9	–	7·9	[illegible]	
–	–	–	–	–	–	–	–	–	–	–	42·8	–	36·1	13·8	3·3	–	–	42·8	–	3·8		–	–	–	–	36·1	13·8	
–	–	7·8	–	–	–	–	–	9·7	–	–	38·0	–	–	29·9	8·1	–	7·8	38·0	–	6·2		–	–	–	–	9·7	29·9	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32·2	–	–	39·5	2·8	25·3	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	40·6	–	33·3	11·9	?	–	–	40·6	–	?	?	–	–	–	–	33·3	11·9	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	35·2	10·4	2·7	8·9	–	–	21·8	–	–	–	11·2	9·8	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	53·5	–	–	trace	–	25·0	trace	–	–	–	–	11·6	–	
–	–	–	–	–	–	–	–	–	–	–	53·3	–	15·2	27·1	1·1	–	–	53·3	–	3·3		–	–	–	–	15·2	27·1	
–	0·20	–	–	0·06	0·86	–	–	1·33	?	0·20	4·50	?	6·43	?	43·2	1·25	0·78	6·57	2·15	18·9	18·8	–	–	0·06	–	7·75	0·28	-f

in two consecutive years.——*c.* Professor Way did not give the amount of ash in each instance. The nitrogen is therefore included under vegetable refuse.——*f.* The water mentioned in first column is in combination, and not expelled by

G 2.—MANURES—MANUFACTURERS', &c., REFUSE.

					General Division.					ENTIRE COMPOSITION									
					In Natural State.					Organic Matter.								Inorganic	
										Ultimate Elements.									
Class.	Manufacture.	Refuse.			Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Authority.	Number of Analyses.
	Soot	House	–	–	Johnston	1	?	70·5	29·5	Völcker	1	–	–	–	0·7	0·9	–	Solly	1
	Soot	House	–	–	Johnston	1	?	74·3	25·7	Völcker	1	–	–	–	4·1	4·9	–	– –	–
	Soot	Laboratory	–	–	Johnston	1	?	51·5	48·5	Völcker	1	–	–	–	1·5	1·8	–	– –	–
	Fish	Sprats	Year	1847	Way	1	64·6	33·3	2·1	Way	1	–	–	–	1·9	2·3	–	Way	1
	Fish	Sprats	Year	1848	Way	1	63·7	34·2	2·1	– –	–	–	–	–	–	–	–	Way	1
Vegetable.	Cider	Apple	–	–	Boussingault and Payen.	1	70·0	30·0 ?		Boussingault and Payen.	1	–	–	–	0·20	0·24	–	– –	–
Vegetable.	Starch	Potato	–	–	Boussingault and Payen.	1	73·0	27·0 ?		Boussingault and Payen.	1	–	–	–	0·53	0·64	–	– –	–
Vegetable.	Sugar	Beetroot	–	–	Boussingault and Payen.	1	70·0	30·0 ?		Boussingault and Payen.	1	–	–	–	0·38	0·46	–	– –	–
Animal.	Woollen	Rags	–	–	Way	1	7·9	82·8	9·3	Way	1	–	–	–	10·5	12·7	–	Nesbit	1
Animal.	Woollen	Prennings	–	–	Way	1	7·0	93·0 ?		Way	1	–	–	–	9·9	12·0	–	– –	–
Animal.	Woollen	Cuttings	–	–	Way	1	8·7	91·3 ?		Way	1	–	–	–	11·8	14·3	–	– –	–
Animal.	Woollen	Shoddy	–	–	Way	1	6·1	93·9 ?		Way	1	–	–	–	4·6	5·5	–	– –	–
Animal.	Woollen	Wool	–	–	Way	1	7·2	58·5	34·3	Way	1	–	–	–	2·5	3·0	–	Way	1
Animal.	Glue	Scutch	–	–	Johnston	1	46·7	27·9	25·4	– –	–	–	–	–	–	–	–	Johnston	1
Animal.	Glue	Scutch	–	–	Way	2	25·9	22·4	51·7	Way	2	–	–	–	1·2	1·5	–	Way	2
Animal.	Horn	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
Animal.	Brewers	Spent Hops	–	–	Nesbit	1	Boussingault 73·0	24·2	2·8	Boussingault and Payen.	1	–	–	–	0·6	0·7	–	Nesbit	1
Mineral.	Soda	Soda Ash	–	–	Way	1	?	–	100	– –	–	–	–	–	–	–	–	Way	1
Mineral.	Carbonate soda.	Alkali waste.	–	–	Way	1	2·1	–	97·9	– –	–	–	–	–	–	–	–	Way	1
Mineral.	Bleachers'	Lime refuse.	–	–	Fromberg	1	10·0 ?	16·7	73·3	– –	–	–	–	–	–	–	–	Fromberg	1
Mineral.	Iron	Iron slag.	–	–	Cameron	1	–	–	100	– –	–	–	–	–	–	–	–	Cameron	1
Mineral.	Soda water.	Lime refuse.	–	–	Johnston	1	70·2	–	29·8	– –	–	–	–	–	–	–	–	Johnston	1
Mineral.	Prussiate potash.	Refuse	–	–	Richardson	1	35·5	–	64·5	– –	–	–	–	–	–	–	–	Richardson	1
Mineral.	Patent Alum.	Refuse	–	–	Richardson	1	27·5	–	72·5	– –	–	–	–	–	–	–	–	Richardson	1
Mineral.	Gas-works.	Lime refuse,	–	–	Johnston	2	11·3	–	88·7	– –	–	–	–	–	–	–	–	Johnston	2
Mineral.	Coal-mine.	Waste heap.	–	–	Anderson	1	1·75	0·92	97·3	Anderson	1	–	–	–	trace	trace	–	Anderson	1

a. From London and Edinburgh, after being exposed to

G 2.—MANURES—MANUFACTURERS', &c., REFUSE.

PER CENT.

Matter or Ash.

	Soluble in Rain Water.														Total Inorganic Matter.													
	Abundantly.									Sparingly.																		
Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia	Iron.	Phosph. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–		Salts 3·48			–	–	–	with salts	–	–	1·86	0·15	2·65	0·15	9·44	Salts 3·48		1·86	0·15	4·51	7·26	–	with salts?		–	2·65	0·15	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
0·15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	trace	0·36	0·03	0·50	0·06	–	0·006	–	–	0·23	0·91	trace	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·006	0·46	–	0·57	0·07	–	0·02	–	0·05	0·05	0·85	0·03	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1·56	0·38	0·19	1·40	0·14	–	1·86	–	–	1·11	1·45	1·20	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–		Salts 0·10			–	–	–	with salts	–	–	5·28	–	–	4·15	21·20	Salts 0·10		5·93	–	2·09		–	with salts		0·82	with salts	4·15	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3·00	–	–	11·80	0·40	–	–	–	–	–	1·40	–	8·80	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11·99	–	–	20·37	0·31	1·29		–	–	–	0·67	3·10	13·75	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1·37	0·04	–	0·66	0·08	–	0·04	trace	0·02	0·08	0·14	0·08	0·25	
–	–	45·9	–	13·9	–	–	–	7·9	16·0	–	5·8	–	–	4·5	3·3	–	45·9	5·8	–	–	2·7	–	–	13·9	–	7·9	20·5	
–	–	–	–	–	–	–	–	–	–	–	41·9	–	35·4	13·5	3·2	–	–	41·9	–	3·7		–	–	–	–	35·4	13·5	
–	–	5·7	–	–	–	–	–	7·1	–	–	27·9	–	–	21·9	5·9	–	5·7	27·9	–	4·6		–	–	–	–	7·1	21·9	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32·2	–	–	39·5	2·8	25·3	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	12·1	–	9·9	3·6	?	–	–	12·1	–	?	?	–	–	–	–	9·9	3·6	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23·3	6·9	1·9	5·9	–	–	14·4	–	–	–	7·5	6·5	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	39·0	–	–	trace	–	25·5	trace	–	–	–	–	8·5	–	
–	–	–	–	–	–	–	–	–	–	–	47·3	–	13·5	24·0	1·0	–	–	47·3	–	2·9		–	–	–	–	13·5	24·0	–*a*
–	0·19	–	–	0·06	0·84	–	–	1·29	?	0·19	4·38	?	6·25	?	42·0	1·22	0·76	6·39	2·09	18·4	18·3	–	–	0·06	–	7·54	0·27	–*b*

the air some time.—*b*. Excellent manure for clover.

G 3.—MANURES—MANUFACTURERS', &c., REFUSE.

Class.	Manufacture.	Refuse.			General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic. Authority.	Number of Analyses.	Total Sulphur.
	Soot	House	–	–	Johnston	1	?	1579	661	Völcker	1	–	–	–	16	20	–	Solly	1	–
	Soot	House	–	–	Johnston	1	?	1664	576	Völcker	1	–	–	–	92	110	–	– –	–	–
	Soot	Laboratory	–	–	Johnston	1	?	1154	1086	Völcker	1	–	–	–	34	41	–	– –	–	–
	Fish	Sprats	Year	1847	Way	1	1447	746	47	Way	1	–	–	–	43	52	–	Way	1	3
	Fish	Sprats	Year	1848	Way	1	1427	766	47	– –	–	–	–	–	–	–	–	Way	1	–
Vegetable.	Cider	Apple	–	–	Boussingault and Payen.	1	1568	672	?	Boussingault and Payen.	1	–	–	–	5	6	–	– –	–	–
Vegetable.	Starch	Potato	–	–	Boussingault and Payen.	1	1635	605	?	Boussingault and Payen.	1	–	–	–	12	15	–	– –	–	–
Vegetable.	Sugar	Beetroot	–	–	Boussingault and Payen.	1	1568	672	?	Boussingault and Payen.	1	–	–	–	9	11	–	– –	–	–
Animal.	Woollen	Rags	–	–	Way	1	177	1855	208	Way	1	–	–	–	235	284	–	Nesbit	1	–
Animal.	Woollen	Prennings	–	–	Way	1	157	2083	?	Way	1	–	–	–	222	267	–	– –	–	–
Animal.	Woollen	Cuttings	–	–	Way	1	195	2045	?	Way	1	–	–	–	264	320	–	– –	–	–
Animal.	Woollen	Shoddy	–	–	Way	1	137	2103	?	Way	1	–	–	–	102	123	–	– –	–	–
Animal.	Woollen	Wool	–	–	Way	1	161	1311	768	Way	1	–	–	–	56	67	–	Way	1	–
Animal.	Glue	Scutch	–	–	Johnston	1	1046	625	569	– –	–	–	–	–	–	–	–	Johnston	1	–
Animal.	Glue	Scutch	–	–	Way	2	580	502	1158	Way	2	–	–	–	27	33	–	Way	2	–
Animal.	Horn	– –	–	–	– –	–	– –	–	–	– –	–	–	–	–	–	–	–	– –	–	–
Animal.	Brewers	Spent Hops	–	–	Nesbit	1	Boussingault 1635	542	63	Boussingault and Payen.	1	–	–	–	14	16	–	Nesbit	1	–
Mineral.	Soda	Soda Ash	–	–	Way	1	?	–	2240	– –	–	–	–	–	–	–	–	Way	1	–
Mineral.	Carbonate of Soda.	Alkali waste.	–	–	Way	1	47	–	2193	– –	–	–	–	–	–	–	–	Way	1	–
Mineral.	Bleachers'	Lime refuse.	–	–	Fromberg	1	224 ?	374	1642	– –	–	–	–	–	–	–	–	Fromberg	1	–
Mineral.	Iron	Iron slag	–	–	Cameron	1	– –	–	2240	– –	–	–	–	–	–	–	–	Cameron	1	–
Mineral.	Soda-water.	Lime refuse.	–	–	Johnston	1	1572	–	668	– –	–	–	–	–	–	–	–	Johnston	1	–
Mineral.	Prussiate of Potash.	Refuse	–	–	Richardson	1	795	–	1445	– –	–	–	–	–	–	–	–	Richardson	1	–
Mineral.	Patent Alum.	Refuse	–	–	Richardson	1	616	–	1624	– –	–	–	–	–	–	–	–	Richardson	1	–
Mineral.	Gas-works.	Lime refuse.	–	–	Johnston	2	253	–	1987	– –	–	–	–	–	–	–	–	Johnston	2	–
Mineral.	Coalmine.	Waste heap	–	–	Anderson	1	39	21	2180	Anderson	1	–	–	–	?	?	–	Anderson	1	–

G 3.—MANURES—MANUFACTURERS', &c., REFUSE.

PER TON, IN POUNDS.

Matter or Ash.

Soluble in Rain-Water.														Total Inorganic Matter.												
Abundantly.									Sparingly.																	
Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulph. Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
Salts 78				–	–	–	with salts	–	?	42	3	59	3	212	Salts 78		42	3	101	163	–	With salts		–	59	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	trace	8	1	11	2	–	0·1	–	–	5	20	trace	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·1	10	–	13	2	–	0·5	–	1	1	19	1	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	35	8	4	31	3	–	42	–	–	25	32	27	?
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	475	Salts 2		133	–	47		–	With salts		18	With salts.	93
–	–	–	–	–	–	–	–	–	–	–	–	–	–	67	–	–	264	9	–	–	–	–	–	31	–	197
–	–	–	–	–	–	–	–	–	–	–	–	–	–	268	–	–	456	7	29		–	–	–	15	69	308
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	31	1	–	15	2	–	1	trace	0·5	2	3	2	6
–	1028	–	311	–	–	–	177	358	–	130	–	–	101	74	–	1028	130	–	–	61	–	–	311	–	177	459
–	–	–	–	–	–	–	–	–	?	939	–	793	302	72	–	–	939	–	83		–	–	–	–	793	302
–	128	–	–	–	–	–	159	–	?	625	–	–	491	132	–	128	625	–	103		–	–	–	–	159	491
–	–	–	–	–	–	–	–	–	–	–	–	–	–	721	–	–	885	63	567	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	?	271	–	222	81	?	–	–	271	–	?	?	?	–	–	–	222	81
–	–	–	–	–	–	–	–	–	–	–	–	–	–	522	155	43	132	–	–	323	–	–	–	168	146	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	874	–	–	trace	–	571	trace	–	–	–	–	190	–
–	–	–	–	–	–	–	–	–	?	1060	–	302	538	22	–	–	1060	–	65		–	–	–	–	302	538
4	–	–	1	19	–	–	29	?	4	98	?	140	?	941	27	17	143	47	412	410	–	–	1	–	169	6

G 4.—MANURES—MANUFACTURERS', &c., REFUSE.

Class.	Manufacture.	Refuse.	Ton.	Cwt.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION PER — Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic Authority.	Number of Analyses.
	Soot . .	House .	–	10	Johnston	1	?	781	331	Völcker .	1	–	–	–	8	10	–	Solly . .	1
		House .	–	10	Johnston	1	?	832	288	Völcker .	1	–	–	–	46	55	–	– –	–
		Laboratory	–	10	Johnston	1	?	577	543	Völcker .	1	–	–	–	17	20	–	– –	–
	Fish . .	Sprats .	1	–	Way . .	1	1447	746	47	Way . .	1	–	–	–	43	52	–	Way . .	1
		Sprats .	1	–	Way . .	1	1427	766	47	– –	–	–	–	–	–	–	–	Way . .	1
Vegetable.	Cider .	Apple .	–	–	Boussingault and Payen.	1	–	–	–	Boussingault and Payen.	1	–	–	–	–	–	–	– –	–
	Starch .	Potato .	–	–	Boussingault and Payen.	1	–	–	–	Boussingault and Payen.	1	–	–	–	–	–	–	– –	–
	Sugar .	Beetroot.	–	–	Boussingault and Payen	1	–	–	–	Boussingault and Payen.	1	–	–	–	–	–	–	– –	–
Animal.	Woollen.	Rags . .	1	–	Way . .	1	177	1855	208	Way . .	1	–	–	–	235	284	–	Nesbit .	1
		Premings	1	–	Way . .	1	157	2083	?	Way . .	1	–	–	–	222	267	–	– –	–
		Cuttings	1	–	Way . .	1	195	2045	?	Way . .	1	–	–	–	264	320	–	– –	–
		Shoddy .	1	–	Way . .	1	137	2103	?	Way . .	1	–	–	–	102	123	–	– –	–
		Wool . .	1	–	Way . .	1	161	1311	768	Way . .	1	–	–	–	56	67	–	Way . .	1
	Glue . .	Scutch .	1	–	Johnston	1	1046	625	569	– –	–	–	–	–	–	–	–	Johnston	1
			1	–	Way . .	2	580	502	1158	Way . .	2	–	–	–	27	33	–	Way . .	2
	Horn . .	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Brewers .	Spent Hops	–	–	Nesbit .	1	Boussingault –	–	–	Boussingault and Payen.	1	–	–	–	–	–	–	Nesbit .	1
Mineral.	Soda . .	Soda Ash	–	1	Way . .	1	?	–	112	– –	–	–	–	–	–	–	–	Way . .	1
	Carbonate soda.	Alkali waste.	1	–	Way . .	1	47	–	2193	– –	–	–	–	–	–	–	–	Way . .	1
	Bleachers	Lime refuse.	–	–	Fromberg	1	–	–	–	– –	–	–	–	–	–	–	–	Fromberg	1
	Iron . .	Iron slag.	–	–	Cameron	1	–	–	–	– –	–	–	–	–	–	–	–	Cameron	1
	Soda water.	Lime refuse.	–	–	Johnston	1	–	–	–	– –	–	–	–	–	–	–	–	Johnston	1
	Prussiate potash.	Refuse .	–	4	Richardson	1	159	–	289	– –	–	–	–	–	–	–	–	Richardson	1
	Patent Alum.	Refuse .	–	4	Richardson	1	123	–	325	– –	–	–	–	–	–	–	–	Richardson	1
	Gas-works.	Lime refuse.	–	–	Johnston	2	–	–	–	– –	–	–	–	–	–	–	–	Johnston	2
	Coal-mine.	Waste heap.	–	–	Anderson	1	–	–	–	Anderson	1	–	–	–	–	–	–	Anderson	1

a. The quantities of each substance applied to one

G 4.—MANURES—MANUFACTURERS', &c., REFUSE.

TATUTE ACRE IN POUNDS.

atter or Ash.

Total Sulphur.	Soluble in Rain Water.														Total Inorganic Matter.													
	Abundantly.									Sparingly.																		
	Potash.	Soda.	Chl. of Potass.	Chl. of Sodium.	Magnesia.	Iron.	Phosph. Acid.	Sulph. Acid.	Carb. Acid.	Silica.	Lime.	Magnesia.	Sulph. Acid.	Carb. Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–		Salts. 39			–	–	–	with salts	–	?	21	1	30	1	106	Salts. 39		21	1	50	82	–	with	salts	–	30	1	-a
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	trace	8	1	11	2	–	0·1	–	–	5	20	trace	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·1	10	–	13	2	–	0·5	–	1	1	19	1	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	35	8	4	31	3	–	42	–	–	25	32	27	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	475	Salts. 2		133	–	47		–	with	salts	18	with salts	93	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	67	–	–	264	9	–	–	–	–	–	31	–	197	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	268	–	–	456	7	29		–	–	–	15	69	308	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	51	–	16	–	–	–	9	18	–	7	–	–	5	4	–	51	7	–	–	3	–	–	16	–	9	23	
–	–	–	–	–	–	–	–	–	–	?	939	–	793	302	72	–	–	939	–	83		–	–	–	–	793	302	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	104	31	9	26	–	–	65	–	–	–	34	29	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	175	–	–	trace	–	114	trace	–	–	–	–	38	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

acre in this table are of course quite arbitrary.

G 4.—MANURES—MANUFACTURERS', &c., REFUSE.

G 4.—MANURES—MANUFACTURERS', &c., REFUSE.

ENTIRE COMPOSITION PER STATUTE ACRE IN POUNDS.

Class.	Manufacture.	Refuse.	Ton.	Cwt.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Org. Organic Matter.	Inorganic Matter or Ash. Authority.	Number of Analyses.
	Soot	House	–	10	Johnston	1	?	761	331	Völcker	1	–	–	–	8	10	–	Solly	1
	Soot	House	–	10	Johnston	1	?	832	288	Völcker	1	–	–	–	46	55	–	– –	–
	Soot	Laboratory	–	10	Johnston	1	?	577	343	Völcker	1	–	–	–	17	20	–	– –	–
	Fish	Sprats	1	–	Way	1	1447	746	47	Way	1	–	–	–	43	52	–	Way	1
	Fish	Sprats	1	–	Way	1	1427	766	47	– –	–	–	–	–	–	–	–	Way	1
Vegetable.	Cider	Apple	–	–	Boussingault and Payen	1	–	–	–	Boussingault and Payen	1	–	–	–	–	–	–	– –	–
Vegetable.	Starch	Potato	–	–	Boussingault and Payen	1	–	–	–	Boussingault and Payen	1	–	–	–	–	–	–	– –	–
Vegetable.	Sugar	Beetroot	–	–	Boussingault and Payen	1	–	–	–	Boussingault and Payen	1	–	–	–	–	–	–	– –	–
	Woollen	Rags	1	–	Way	1	177	1835	208	Way	1	–	–	–	233	284	–	Nesbit	1
	Woollen	Premings	1	–	Way	1	157	2083	?	Way	1	–	–	–	222	267	–	– –	–
	Woollen	Cuttings	1	–	Way	1	193	2045	?	Way	1	–	–	–	264	320	–	– –	–
	Woollen	Shoddy	1	–	Way	1	197	2103	?	Way	1	–	–	–	102	123	–	– –	–
	Woollen	Wool	1	–	Way	1	161	1311	768	Way	1	–	–	–	56	67	–	Way	1
	Glue	Scotch	1	–	Johnston	1	1046	623	569	– –	–	–	–	–	–	–	–	Johnston	1
	Glue	Scotch	1	–	Way	2	350	502	1155	Way	2	–	–	–	27	33	–	Way	2
	Horn	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Brewers	Spent Hops	–	–	Nesbit	1	Boussingault –	–	–	Boussingault and Payen	1	–	–	–	–	–	–	Nesbit	1
Mineral.	Soda	Soda Ash	–	1	Way	1	?	–	112	– –	–	–	–	–	–	–	–	Way	1
Mineral.	Carbonate soda	Alkali waste	–	–	Way	1	47	–	2193	– –	–	–	–	–	–	–	–	Way	1
Mineral.	Bleacher	Lime refuse	–	–	Fromberg	1	–	–	–	– –	–	–	–	–	–	–	–	Fromberg	1
Mineral.	Iron	Iron slag	–	–	Cameron	1	–	–	–	– –	–	–	–	–	–	–	–	Cameron	1
Mineral.	Soda water	Lime refuse	–	–	Johnston	1	–	–	–	– –	–	–	–	–	–	–	–	Johnston	1
Mineral.	Prussiate potash	Refuse	–	4	Richardson	1	159	–	289	– –	–	–	–	–	–	–	–	Richardson	1
Mineral.	Patent Alum	Refuse	–	4	Richardson	1	123	–	325	– –	–	–	–	–	–	–	–	Richardson	1
Mineral.	Gas works	Lime refuse	–	–	Johnston	2	–	–	–	– –	–	–	–	–	–	–	–	Johnston	2
Mineral.	Coal mine	Waste slag	–	–	Anderson	1	–	–	–	Anderson	1	–	–	–	–	–	–	Anderson	1

Refuse.	Total Sulphur.	Soluble in Rain Water. Abundantly. Potash.	Soda.	Chl. of Potass.	Chl. of Sodium.	Magnesia.	Iron.	Phosph. Acid.	Sulph. Acid.	Carb. Acid.	Sparingly. Silica.	Lime.	Magnesia.	Sulph. Acid.	Carb. Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
Soot, House	–		Salts. 19			–	–	–	with salts	–	7	21	1	30	1	106	Salts. 62		21	–	50	82		with salts		–	30	1[a]
Soot, House		–	–			–	–	–			–	–	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–
Soot, Laboratory	–	–		–	–		–	–		–	–	–	–	–	–	–	–	–	–	–		–	–			–	–	
Fish, Sprats	3		–		–	–	–	–	–	–	–	–	–		–	trace	8	1	11	–	–	1	–	–	5	20	trace	–
Fish, Sprats	–	–	–	–	–	–	–	–			–	–	–	–	–	0·1	10	–	13	2		·5	–	1	1	18	1	–
Cider, Apple	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–
Starch, Potato	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sugar, Beetroot	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Woollen, Rags	–	–		–	–	–		–	–	–	–	–	–	–	–	25	8	4	31	3	–	42	–	–	15	52	27	?
Woollen, Premings	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Woollen, Cuttings	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–
Woollen, Shoddy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Woollen, Wool	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	475	Salts. 2		133	–	47		–	with salts		18	with salts	33
Glue, Scotch	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	67	–	–	284	9	–	–	–	–	–	31	–	197
Glue, Scotch	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	258	–	–	456	7	29		–	–	–	15	69	24
Horn	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brewers, Spent Hops	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Soda, Soda Ash	–	–	51	–	16	–	–	–	9	18	–	7	–	–	5	4	–	51	7	–	–	3	–	–	16	–	9	23
Carbonate soda, Alkali waste	–	–	–	–	–	–	–	–	–	–	7	939	–	791	312	72	–	–	939	–	83		–	–	–	–	793	313
Bleacher, Lime refuse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Iron, Iron slag	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Soda water, Lime refuse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Prussiate potash, Refuse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	104	31	9	26	–	–	[illegible]	–	–	–	34	29	
Patent Alum, Refuse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	175	–	–	trace	–	114	trace	–	–	–	–	38	–
Gas works, Lime refuse	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Coal mine, Waste slag	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

a. The quantities of each substance applied to one acre in this table are of course quite arbitrary.

H 1.—LIQUID MANURES.

Class.	Species.		Grains in 1 Gallon.		General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF Organi Ultimat Authority.	Number of Analyses.	Carbon.	Hydrogen.
Farm.	Drainings of Farm Yard Manure.	— —	479	—	Johnston . .	1	—	43·8	56·2	Johnston .	1	—	—
		Watered with cows' urine	617	—	Johnston . .	1	—	16·0	84·0	Johnston .	1	—	—
		Tank . .	1209	—	Way . . .	1	—	32·9	67·1	Way . .	1	—	—
Urine.	Man	— —	—	—	Berzelius . .	1	—	71·4	28·6	— —	—	—	—
		— —	—	—	Lehman . .	10	—	72·7	27·3	Boussingault and Payen	1	—	—
	Horse	— —	—	—	— —	—	—	—	—	— —	—	—	—
		— —	—	—	Von Bibra .	2	—	59·4	40·6	Boussingault and Payen	1	—	—
	Cow	— —	—	—	— —	—	—	—	—	— —	—	—	—
		— —	—	—	Von Bibra .	2	—	67·1	32·9	Boussingault and Payen	1	—	—
		— —	—	—	Sprengel . .	1	—	67·8	32·2	— —	—	—	—
	Sheep	— —	—	—	Fromberg .	1	—	71·9	28·1	Fromberg .	1	—	—
		— —	—	—	Sprengel . .	1	—	70·0	30·0	— —	—	—	—
	Pig	— —	—	—	Sprengel . .	1	—	76·2	23·8	— —	—	—	—
		— —	—	—	Von Bibra .	2	—	46·7	53·3	— —	—	—	—
Irrigation Water.	Sewage-water .	Clear . .	85·3	—	Brande . .	4	—	and alk. 67·7	32·3	Brande . .	4	—	—
		Deposit .	55·0	—	Brande . .	4	—	38·6	61·4	— —	—	—	—
		?	52·0	—	Millar . .	1	—	17·4	82·6	Millar . .	1	—	—
		Clear . .	77·3	—	Cooper . .	1	—	not determined		— —	—	—	—
		Clear . .	78·0	—	Cooper . .	1	—	,,		— —	—	—	—
		— —	492·0	—	Way . . .	1	—	61·4	38·6	Way . .	1	—	—
	Natural waters .	River . .	17·4	—	Johnston . .	4	—	9·8	90·2	— —	—	—	—
			350	—	Herepath . .	1	—	6·2	93·8	Herepath .	1	—	—
		Spring .	15·5	—	Johnston . .	22	—	not determined		— —	—	—	—
			5·2	—	Völcker . .	1	5·8	14·6	79·6	— —	—	—	—
		Land Drains.	25·3	—	Way . . .	1	—	4·9	95·1	— —	—	—	—
			0·8	—	Wilson . .	1	—	24·5	75·5	— —	—	—	—
			1·5	—	Wilson . .	1	—	30·7	69·3	— —	—	—	—
Manufacturers' Refuse.	Flax-water . .	— —	?	—	Sir R. Kane .	1	—	58·0	42·0	Sir R. Kane	1	52·9	7·
		— —	445	—	Way . . .	1	—	40·6	59·4	Way . .	1	—	—
	Gas Liquor . .	— —	—	—	— —	—	—	—	—	— —	—	—	—
	Still-refuse . .	— —	4235	thin	Johnston . .	1	—	90·6	9·39	— —	—	—	—
		— —	10884	thick	Johnston . .	1	—	94·2	5·80	— —	—	—	—
	Spent Leys of Bleach-works.	— —	1432	—	Johnston . .	1	—	42·0	58·0	— —	—	—	—

H 1.—LIQUID MANURES.

EACH PORTION PER CENT.															
Matter.					Inorganic Matter or Ash.										
Elements.							Soluble in Rain Water.								
							Abundantly.								
Oxygen.	Nitrogen.	Ammonia.	Humus.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chl. of Potass.	Chl. of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carb. Acid.
–	3·8	4·6	–	Johnston . .	1	–		77·3			–	–	–	with alkalies	?
–	18·0	21·7	–	Johnston . .	1	–		81·1			–	–	–	,,	?
–	74·3	89·9	–	Way . . .	1	–	43·5	–	4·3	18·7	–	–	1·1	13·0	12·3
–	–	–	–	Berzelius . .	1	–	–	–	–	–	–	–	–	–	–
–	24·0	29·0	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Boussingault	1	–	–	–	–	–	–	–	–	–	–
–	21·0	25·4	–	Von Bibra .	1	–	38·7	6·1	–	7·0	–	–	–	5·9	18·7
–	–	–	–	Boussingault	1	–	–	–	–	–	–	–	–	–	–
–	5·7	6·9	–	Von Bibra .	1	–	53·4	–	–	0·4	–	–	–	6·0	21·2
–	–	–	–	Sprengel . .	1	–	27·7	23·1	chl. 11·4		–	–	?	17·2	?
–	11·8	14·3	–	Fromberg .	1	–	1·6	28·4	12·0	32·0	–	–	–	5·7	17·2
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Boussingault	1	–	31·8	–	–	24·6	–	–	8·4	17·2	–
–	–	–	–	Von Bibra .	1	–	8·3	12·1	–	53·1	–	–	10·0	3·9	3·8
–	3·9	4·7	67·7	Brande . .	4	–	–	–	chl. 36·3		–	–	0·6	2·3	–
–	–	–	–	Brande . .	4	–	–	–	–	–	–	–	–	–	–
–	28·8	34·9	?	Millar . .	1	–	2·4	–	–	31·8	–	–	?	–	–
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	11·2	13·6	24·7	Way . . .	1	–	24·7	–	–	16·6	1·5	trace	4·0	5·6	6·1
–	–	–	?	Johnston . .	4	–	–	–	–	–	–	–	–	–	–
–	4·1	5·0	?	Herepath. .	1	–	–	0·14	1·1		0·06	–	–	0·30	–
–	–	–	–	Johnston . .	22	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Völcker . .	1	–		salts 27·4			–	–	–	–	–
–	–	–	?	Way . . .	1	–	–	–	–	7·1	–	–	–	–	–
–	–	–	?	Wilson . .	1	–	–	6·9	36·7		4·5	20·0?	–	5·6	–
–	–	–	?	Wilson . .	1	–	–	5·9	chl. 16·6		3·6	12·7?	–	?	–
35·9	3·9	4·7	–	Sir R. Kane .	1	–	–	–	–	–	–	–	–	–	–
–	1·8	2·2	?	Way . . .	1	–	–	?	–	–	–	–	–	–	–
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Johnston . .	1	–	46·3		?	?	–	–	21·7	?	–
–	–	–	–	Johnston . .	1	–	38·4		?	?	–	–	24·4	?	–
–	–	–	–	Johnston . .	1	–	–	49·8	–	11·2	–	–	–	8·0	28·0

II I.—LIQUID MANURES.

Class.	Species.	Variety.	Grains in 1 Gallon.		Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.
					General Division. Dried at 212° Fahr.					COMPOSITION OF Organic Elements.			
Farm	Drainings of Farm Yard Manure.	— —	[illegible]	—	Johnston . .	1		[illegible]	[illegible]	Johnston . .	1	—	—
		Watered with [illegible]	617	—	Johnston . .	1	—	16·0	84·0	Johnston . .	1	—	—
		Tank . .	1500	—	Way . . .	1	—	32·9	67·1	Way . .	1	—	—
Urine.	Man	— —	—	—	Berzelius . .	1	—	71·4	28·6	— —	—	—	—
		— —	—	—	Lehmann . .	10	—	72·7	27·3	Boussingault and Payen	1	—	—
	Horse	— —	—	—	— —	—	—	—	—	— —	—	—	—
		— —	—	—	Von Bibra .	2	—	59·4	40·6	Boussingault and Payen	1	—	—
	Cow	— —	—	—	— —	—	—	—	—	— —	—	—	—
		— —	—	—	Von Bibra .	2	—	67·1	32·9	Boussingault and Payen	1	—	—
		— —	—	—	Sprengel . .	1	—	67·8	32·2	— —	—	—	—
	Sheep . . .	— —	—	—	Fromberg .	1	—	71·9	28·1	Fromberg .	1	—	—
		— —	—	—	Sprengel . .	1	—	70·0	30·0	— —	—	—	—
	Pig	— —	—	—	Sprengel . .	1	—	76·2	23·8	— —	—	—	—
		— —	—	—	Von Bibra .	2	—	46·7	53·3	— —	—	—	—
Irrigation Water.	Sewage-water .	Clear . . .	86·3	—	Brande .	4	—	[illegible]	[illegible]	Brande . .	1	—	
		Deposit .	55·0	—	Brande . .	4	—	38·6	61·4	— —	—	—	—
		Clear? . .	59·0	—	Millar . .	1	—	17·4	82·6	Millar . .	1	—	—
			77·3	—	Cooper . .	1	—	not determined					
		Clear . .	76·0	—	Cooper . .	1	—			— —	—	—	—
		— —	492·0	—	Way . . .	1	—	61·4	38·6	Way . .	1		—
	Natural waters.	River . .	17·4	—	Johnston .	4	—	[illegible]	[illegible]	—			
			730	—	Herapath. .	1		[illegible]	[illegible]	Herapath .	1	—	
		Spring	15·5	—	Johnston . .	22	—	not determined		— —	—	—	—
			5·2	—	Völcker . .	1	5·8	14·6	79·6	— —	—	—	—
			25·3	—	Way . . .	1	—	4·9	95·1	— —	—	—	—
		Land Drains.	0·8	—	Wilson . .	1	—	24·5	75·5	— —	—	—	—
			1·5	—	Wilson . .	1	—	30·7	69·3	— —	—	—	—
Manufacturers' Refuse.	Flax-water . .	— —	?	—	Sir R. Kane .	1	—	58·0	42·0	Sir R. Kane	1	52·9	7·3
		— —	445	—	Way . .	1	—	40·6	59·4	Way . .	1	—	—
	Gas Liquor . .	— —	—	—	— —	—	—	—	—	— —	—	—	—
	Still-refuse . .	— —	4235	thin	Johnston . .	1	—	90·6	9·39	— —	—	—	—
		— —	10884	thick	Johnston . .	1	—	94·2	5·80	— —	—	—	—
	Spent Leys of Bleach-works.	— —	1432	—	Johnston . .	1	—	42·0	58·0	— —	—	—	—

II I. LIQUID MANURES.

EACH PORTION PER CENT.

Species.	Oxygen.	Nitrogen.	Ammonia.	Humus.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chl. of Potass.	Chl. of Sodium.	Magnesia.	Lime.	Phos. Acid.	Sulph. Acid.	Carb. Acid.
	Organic Matter. Elements.				Inorganic Matter or Ash.			[illegible] in Rain Water. Abundantly.								
Drainings of Farm Yard Manure.	—	3·8	4·6	—	Johnston . .	1	—		77·3			—	—	—	with alkalies	?
Watered	—	18·0	21·[illegible]		Johnston . .	[illegible]	—		81·1			—	—	—	[illegible]	?
Tank	—	74·3	80·9	—	Way . . .	1	—	43·5	—	4·3	18·7	—	—	1·1	13·0	12·3
Man	—	24·0	29·0	—	Berzelius . .	1	—	—	—	—	—	—	—	—	—	—
	—			—	— —	—	—	—	—	—	—	—	—	—	—	—
Horse	—			—	Boussingault	1	—	—	—	—	—	—	—	—	—	—
		21·0	25·4	—	Von Bibra .	1	—	38·7	6·1	—	7·0	—		—	5·9	15·7
Cow	—			—	Boussingault	1	—	—	—	—	—	—	—	—	—	—
	—	6·7	6·9	—	Von Bibra .	1	—	53·4	—	—	0·4	—	—	—	6·0	21·2
			—		Sprengel .	1		57·7	13·3	chl. [illegible]					17·2	?
Sheep	—	11·8	14·3	—	Fromberg .	1	—	1·6	25·4	12·0	35·0	—	—	—	5·7	17·2
	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—
Pig	—	—	—	—	Boussingault	1	—	31·8	—	—	21·6	—	—	5·4	17·2	—
	—	—	—	—	Von Bibra .	1	—	[illegible]	10·1	—	[illegible]		—	10·0	7·0	3·6
Sewage-water	—	3·5	4·7	67·7	Brande . .	4	—	—	—	chl. 30·3		—	—	6·7	[illegible]	—
	—	—	—	—	Brande . .	4	—	—	—	—	—	—	—	—	—	—
	—	29·8	31·0	?	Millar . .	1	—	2·1	—		31·8	—			—	—
	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—
	—	11·2	15·6	21·7	Way .	1	—	21·7			16·6	1·5	trace	4·1		6·1
Natural waters			—	?	Johnston . .	4	—	—	—		—	—	—	—	—	
	—	4·1	5·0	?	Herepath. .	1	—	—	0·14	1·1		0·06	—	—	0·50	—
	—	—	—	—	Johnston . .	22	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	Völcker . .	1	—		salts 27·4			—	—	—	—	—
	—	—	—	?	Way . . .	1	—	—	—	—	7·1	—	—	—	—	—
	—	—	—	?	Wilson . .	1	—	—	6·9	26·7		4·5	20·02	—	5·6	—
		—	—	?	Wilson . .	1	—	—	5·0	chl. 16·6		9·0	10·72	—	?	—
Flax-water	35·9	3·9	4·7	—	Sir R. Kane .	1	—	—	—	—	—	—	—	—	—	—
	—	1·8	2·2	?	Way . . .	1	—	—	?	—	—	—	—	—	—	—
Gas Liquor	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—
Still-refuse			—	—	Johnston . .	1	—	16·[illegible]					—			—
	—	—	—	—	Johnston . .	1	—	38·4		?	?	—	—	24·4	?	—
Spent Leys of Bleach-works	—	—	—	—	Johnston . .	1	—	—	42·8		[illegible]			—	[illegible]	[illegible]

H 1, *continued.*—LIQUID MANURES.

Class.	Species.		Authority.	Number of Analyses.	COMPOSITION OF Inorganic Soluble in Rain Water. Sparingly. Silica.	Lime.	Magnesia	Sulph. Acid.	Carb. Acid.
Farm.	Drainings of Farm Yard Manure.	— —	Johnston . . .	1	?	3·8	0·8	—	3·7
		Watered with cows' urine.	Johnston . . .	1	?	3·4	0·3	—	3·0
		Tank	Way	1	1·0	2·6	1·2	—	?
Urine.	Man	— —	Berzelius . . .	1	—	—	—	—	—
		— —	— —	—	—	—	—	—	—
	Horse	— —	Boussingault . .	1	—	—	—	—	—
		— —	Von Bibra . .	1	0·6	7·0	4·5	—	10·5
	Cow	— —	Boussingault . .	1	—	—	—	—	—
		— —	Von Bibra . .	1	0·4	6·6	3·3	—	8·3
		— —	Sprengel . . .	1	1·7	2·9	1·7	—	?
	Sheep	— —	Fromberg . . .	1	1·1	0·5	0·2	—	0·6
		— —	— —	—	—	—	—	—	—
	Pig	— —	Boussingault . .	1	1·3	trace	8·0	—	8·7
		— —	Von Bibra . . .	1	trace	—	—	—	—
Irrigation Water.	Sewage-water . .	Clear	Brande	4	22·8	26·5	—	—	3·1
		Deposit . . .	Brande	4	—	4·7	—	2·8	2·3
		?	Millar	1	—	?	—	—	—
		Clear	— —	—	—	—	—	—	—
		Clear	— —	—	—	—	—	—	—
		— —	Way	1	0·8	4·0	—	—	—
	Natural waters .	River	Johnston . . .	4	—	—	—	—	—
			Herepath . . .	1	?	6·0	0·15	0·6	4·0
		Spring. . . .	Johnston . . .	22	6·5	—	—	—	—
			Völcker . . .	1	22·1	17·6	5·3	19·5	8·1
		Land Drains.	Way.	1	11·3	43·3	1·9	5·3	31·1
			Wilson	1	10·4	11·5	—	—	—
			Wilson	1	4·5	20·7	9·6	?	7·0
Manufacturers' Refuse.	Flax-water . . .	— —	Sir R. Kane . .	1	—	—	—	—	—
		— —	Way.	1	—	—	?	—	—
	Gas Liquor . . .	— —	— —	—	—	—	—	—	—
	Still-refuse . . .	— —	Johnston . . .	1	—	—	—	—	—
		— —	Johnston . . .	1	—	—	—	—	—
	Spent Leys of Bleach-works.	— —	Johnston . . .	1	0·5	0·2	0·1	—	0·2

a. The tank contained the drainings of cow-house and piggeries, without any water, except what was added at plea-
and lactic acids; the urine being evaporated only.——*c.* Ditto.——*d.* King's Scholars' Pond, London.——*e.* Ditto.
——*l.* After winter fallow.——*m.* The same after being dressed with guano, and sown with barley.——*n.* See re-
may probably prove good drinks for cattle.

H 1, *continued.*—LIQUID MANURES.

ACH PORTION PER CENT—*continued.*

atter or Ash—*continued.*

Total Inorganic Matter.

Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
5·0	salts 77·3		phos. 9·4 +	carb. 8·3	with silica.	with phos.	–	with salts		with lime and mag.	with salts	with lime and mag.	
3·6	salts 81·1		phos. 8·6 +	carb. 6·7	,,	?	–	,,		,,	,,	,,	
1·5	43·5	–	2·6	1·2	–	1·7	–	4·3	18·7	1·1	13·0	12·3	–a
0·2	11·5	15·8	2·3		–	–	–	–	25·1	25·3	19·5	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	
2·4	21·4	–	14·2	4·5	–	–	–	–	1·7	–	1·2	16·1	–b
0·6	38·7	6·1	7·0	4·5	–	trace	–	–	7·0	–	5·9	29·2	
trace	26·5	–	0·7	5·0	–	–	–	–	3·4	–	3·7	6·3	–c
0·4	53·4	–	6·0	3·3	–	trace	–	–	0·4	–	6·0	29·5	
1·7	27·7	23·1	2·9	1·7	0·3		–	chl. 11·4		2·9	17·2	10·9	
1·1	1·6	28·4	0·5	0·2	phos. 0·7		–	12·0	32·0	lime, mag. and iron.	5·7	17·8	
–	–	–	–	–	–	–	–	–	–	–	–	–	
1·3	31·8	–	trace	8·0	–	–	–	–	24·6	8·4	17·2	8·7	
trace	8·3	12·1	3·7		–	trace	–	–	53·1	15·1	3·9	3·8	
22·8	with sol. org. mat.		30·2	–	with silica.	?	–	chl. 36·3		5·3	2·3	3·1	–d
64·1	–	–	13·5	–	,,	5·9	–	–	–	11·4	2·8	2·3	
1·3	2·4	–	18·5	4·3	–	trace	–	–	31·8	15·0	16·4	10·3	–e
–	–	–	–	–	–	–	–	–	–	–	–	–	–f
–	–	–	–	–	–	–	–	–	–	–	–	–	–g
17·4	25·3	0·8	12·9	1·5	3·2		–	–	17·5	5·5	7·7	8·2	–h
4·5	6·4	5·1	25·3	7·6	–	3·2	–	–	with soda	–	13·9	23·5	
69·2	0·5	0·2	6·1	3·0	8·7	5·9	trace	1·1		0·5	0·9	4·0	–i
6·5	–	–	–	–	–	–	–	–	–	–	–	–	
22·1	salts 27·4		17·6	5·3	–	–	–	–	with salts	–	19·5	8·1	
11·3	–	–	43·3	1·9	–	–	–	–	7·1	–	5·3	31·1	–k
10·4	–	6·9	11·5	2·7	4·5	20·0	–	chl. 36·7		1·7	5·6	–	–l
4·5	–	5·9	20·7	13·2	1·3	12·7	–	chl. 16·6		18·1	?	7·0	–m
21·3	9·8	9·8	12·3	7·8	6·1	?	–	chl. 2·4		10·8	2·7	17·0	–n
1·9	18·5	–	12·5	3·2	–	6·6	–	23·0	16·0	3·3	6·8	8·2	–o
–	–	–	–	–	–	–	–	–	–	–	–	–	
2·6	salts 46·3		12·1		–	–	–	with pot. and sod.		38·5	with pot. and soda.	–	–p
21·0	salts 38·4		6·7		–	–	–	,,		33·6	,,	–	
0·5	–	49·8	0·2	0·1	0·2		–	–	11·2	–	8·0	30·0	

sure; when analysed it was in a putrid state.——*b.* The deficiency in this analysis is composed of hippuric
——*f.* Mansfield.——*g.* Edinburgh.——*h.* London.——*i.* Specimen of warp of average quality.——*k.* In pasture.
marks on flax.——*o.* In putrid state.——*p.* I have repeated these two analyses in the table on feeding, as they

H 1, *continued.*—LIQUID MANURES.

COMPOSITION OF EACH PORTION PER CENT—*continued.*

Inorganic Matter or Ash—*continued.*

Class.	Species.		Authority.	Number of Analyses.	Soluble in Rain Water. Sparingly. Silica.	Lime.	Magnesia.	Sulph. Acid.	Carb. Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
Farm.	Drainings of Farm Yard Manure.	— —	Johnston . . .	1	?	3·8	0·8	—	3·7	5·0	salts 77·3		phos. 9·4 +	carb. 8·3	with silica.	with phos.	—	with salts		with lime and mag.	with salts	with lime and mag.	
		Watered with cows' urine	Johnston . . .	1	?	7·1	0·3	—	3·0	3·6	salts 81·1		phos. 6·6 +	carb. 6·7	"	?	—	"		"	"	"	
		Tank	Way	1	1·0	2·6	1·2	—	?	1·5	43·5	—	2·6	1·2	—	1·7	—	4·3	18·7	1·1	13·0	12·3	-a
Urine.	Man	— —	Berzelius . . .	1	—	—	—	—	—	0·8	11·5	13·6	2·8		—	—	—	—	25·1	25·3	10·5	?	
		— —	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Horse	— —	Boussingault . .	1	—	—	—	—	—	2·4	21·4	—	14·2	4·5	—	—	—	—	1·7	—	1·2	16·1	-b
		— —	Von Bibra . .	1	0·6	7·0	4·5	—	10·5	0·6	38·7	6·1	7·0	4·5	—	trace	—	—	7·0	—	5·9	29·2	
	Cow	— —	Boussingault . .	1	—	—	—	—	—	trace	26·5	—	0·7	5·0	—	—	—	—	3·4	—	3·7	6·3	-c
		— —	Von Bibra . .	1	0·4	6·0	3·3	—	5·5	0·4	53·4	—	6·0	3·3	—	trace	—	—	0·4	—	6·0	29·5	
		— —	Sprengel . . .	1	1·7	2·9	1·7	—	?	1·7	27·7	23·1	2·9	1·7	0·3		—	chl. 11·4		2·9	17·3	10·9	
	Sheep	— —	Fromberg . . .	1	1·1	0·5	0·2	—	0·6	1·1	1·6	26·4	0·5	0·2	phos. 0·7		—	12·0	32·0	lime, mag. and iron	5·7	17·9	
		— —	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Pig	— —	Boussingault . .	1	1·3	trace	6·0		5·7	1·3	31·8	—	trace	6·0	—	—	—	—	24·6	6·4	17·2	5·7	
		— —	Von Bibra . . .	1	trace	—	—		—	trace	5·3	12·1	3·7		—	trace	—	—	53·1	15·1	3·9	3·8	
Irrigation Water.	Sewage-water . .	Clear	Brande	4	22·8	25·5	—	—	3·1	22·8	with sol. org. mat.		30·9	—	with silica.	?	—	chl. 30·3		5·3	2·3	3·1	-d
		Deposit . . .	Brande	4	—	4·7	—	2·8	2·3	64·1	—	—	13·5	—	"	5·0	—	—	—	11·4	2·8	2·3	-d
		?	Millar	1	—	?	—	—	—	1·3	2·4	—	18·5	4·3	—	trace	—	—	31·8	15·0	16·4	10·3	-e
		Clear	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-f
		Clear	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-g
		— —	Way	1	0·8	4·?	—	—	—	17·4	23·3	0·8	12·9	1·5	3·2		—	—	17·5	3·5	7·7	8·2	-h
	Natural waters .	River	Johnston . . .	4	—	—	—	—	—	4·5	6·4	3·1	23·3	7·6	—	3·2	—	—	with soda	—	13·0	23·5	
			Herepath . . .	1	?	6·0	0·15	0·6	4·0	59·2	0·5	0·2	6·1	3·0	5·7	5·9	trace	1·1		0·5	0·9	4·0	-i
		Spring. . . .	Johnston . . .	23	6·5	—	—	—	—	6·5	—	—	—	—	—	—	—	—	—	—	—	—	
			Völcker . . .	1	22·1	17·6	5·3	19·5	8·1	22·1	salts 27·4		17·6	5·3	—	—	—	—	with salts	—	19·5	8·1	
		Land Drains.	Way.	1	11·3	43·3	1·9	5·3	31·1	11·3	—	—	43·3	1·9	—	—	—	—	7·1	—	5·3	31·1	-k
			Wilson	1	10·4	11·5	—	—	—	10·4	—	6·9	11·5	2·7	4·5	20·0	—	chl. 30·7		1·7	5·6	—	-l
			Wilson	1	4·5	20·7	9·6	?	7·0	4·5	—	5·9	20·7	13·2	1·3	12·7	—	chl. 16·6		16·1	?	7·0	-m
Manufacturers' Refuse.	Flax-water . . .	— —	Sir R. Kane . .	1	—	—	—	—	—	21·3	9·8	9·8	12·3	7·8	6·1	?	—	chl. 2·4		10·8	2·7	17·0	-n
		— —	Way.	1	—	—	?	—	—	1·9	16·5	—	12·5	3·2	—	6·6	—	23·0	16·0	3·3	6·8	8·2	-o
	Gas Liquor . . .	— —	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Still-refuse . . .	— —	Johnston . . .	1	—	—	—	—	—	2·6	salts 46·3		12·1		—	—	—	with pot. and sod.		35·5	with pot. and soda.	—	-p
		— —	Johnston . . .	1	—	—	—	—	—	21·0	salts 35·4		6·7		—	—	—	"		33·6	"	—	-p
	Spent Lees of Bleach-works.	— —	Johnston . . .	1	0·5	0·2	0·1	—	0·2	0·5	—	49·9	0·2	0·1	0·3		—	—	1·2	—	8·0	30·0	

a. The tank contained the drainings of cow house and piggeries, without any water, except what was added at pleasure; when analysed it was in a putrid state.—*b.* The deficiency in this analysis is composed of hippuric and lactic acids; the urine being evaporated only.—*c.* Ditto.—*d.* King's Scholars' Pond, London.—*e.* Ditto.—*f.* Mansfield.—*g.* Edinburgh.—*h.* London.—*i.* Specimen of warp of average quality.—*k.* In pasture.—*l.* After winter fallow.—*m.* The same after being dressed with guano, and sown with barley.—*n.* See remarks on flax.—*o.* In putrid state.—*p.* I have repeated these two analyses in the table on feeding, as they may probably prove good drinks for cattle.

H 2.—LIQUID MANURES.

Class.	Species.				General Division.					ENTIRE			
					In Natural State.					Organi			
										Ultimate			
					Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.
Farm	Drainings	Manure	–	–	Johnston	1	99·3	0·30	0·39	Johnston	1	–	–
		Ditto, watered with cows' urine.	–	–	Johnston	1	98·1	1·14	0·74	Johnston	1	–	–
		Tank	–	–	Way	1	98·3	0·57	1·15	Way	1	–	–
Urine.	Man	– –	–	–	Berzelius	1	93·3	4·78	1·92	– –	–	–	–
		– –	–	–	Lehman	10	93·6	4·65	1·75	Boussingault and Payen.	1	–	–
	Horse	– –	–	–	Von Bibra	2	89·9	6·0	4·1	Boussingault and Payen.	1	–	–
	Cow	– –	–	–	Von Bibra	2	91·8	5·5	2·7	Boussingault and Payen.	1	–	–
		– –	–	–	Sprengel	1	92·6	5·02	2·38	– –	–	–	–
	Sheep	– –	–	–	Fromberg	1	92·9	5·10	2·00	Fromberg	1	–	–
		– –	–	–	Sprengel	1	96·0	2·80	1·20	– –	–	–	–
	Pig	– –	–	–	Sprengel	1	92·6	5·64	1·76	– –	–	–	–
		– –	–	–	Von Bibra	2	98·2	0·84	0·96	– –	–	–	–
Irrigation Water.	Sewage-water	Clear	–	–	Brande	4	99·88	and alkalies 0·08	0·04	Brande	4	–	–
		Deposit	–	–	Brande	4	99·92	0·03	0·05	– –	–	–	–
		?	–	–	Millar	1	99·93	0·01	0·06	Millar	1	–	–
		Clear	–	–	Cooper	1	99·89	0·11		Cooper	1	–	–
		Clear	–	–	Cooper	1	99·89	0·11		Cooper	1	–	–
		– –	–	–	Way	1	93·00	4·30	2·70	Way	1	–	–
	Natural Waters	River	–	–	Johnston	4	99·98	0·003	0·022	– –	–	–	–
			–	–	Herepath	1	95·0	0·3	4·7	Herepath	1	–	–
		Spring	–	–	Johnston	22	99·98	0·021		– –	–	–	–
			–	–	Völcker	1	99·99	0·001	0·006	– –	–	–	–
			–	–	Way	1	99·96	0·002	0·034	– –	–	–	–
		Land drains	–	–	Wilson	1	100	0·0003	0·0008	– –	–	–	–
			–	–	Wilson	1	100	0·0007	0·0014	– –	–	–	–
Manufacturers' Refuse.	Flax-water	– –	–	–	Way	1	93·63	2·59	3·78	Way	1	–	–
	Gas Liquor	– –	–	–	– –	–	–	–	–	– –	–	–	–
	Still refuse	Thin	–	–	Johnston	1	93·95	5·48	0·57	– –	–	–	–
		Thick	–	–	Johnston	1	84·5	14·6	0·90	– –	–	–	–
	Spent Leys, Bleach-works.	– –	–	–	Johnston	1	98·0	0·84	1·19	– –	–	–	–

H 2.—LIQUID MANURES.

OMPOSITION PER CENT.															
Iatter.				Inorganic Matter or Ash.											
Elements.		Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Soluble in Rain-water.								
							Abundantly.								
Oxygen.	Nitrogen.						Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.
–	0·012	0·014	–	Johnston . .	1	–		Salts 0·302			–	–	–	With salts.	?
–	0·025	0·031	–	Johnston . .	1	–		Salts 0·600			–	–	–	,,	?
–	0·423	0·512	–	Way . . .	1	–	0·500	–	0·049	0·215	–	–	0·013	0·149	0·142
–	–	–	–	Berzelius . .	1	–	0·22	0·30	–	0·48	–	–	0·49?	0·37	?
–	1·12	1·36	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	1·26	1·52	–	Von Bibra .	1	–	1·59	0·25	–	0·29	–	–	–	0·24	?
–	0·31	0·38	–	Von Bibra .	1	–	1·44	–	–	0·01	–	–	–	0·16	?
–	–	–	–	Sprengel . .	1	–	0·66	0·55	Chl. 0·27		–	–	?	0·41	?
–	0·59	0·71	–	Fromberg .	1	–	0·032	0·568	0·240	0·640	–	–	?	0·114	0·344
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Boussingault	1	–	0·56	–	–	0·43	–	–	?	0·30	?
–	–	–	–	Von Bibra .	1	–	0·08	0·12	–	0·51	–	–	?	0·04	?
–	0·003	0·004	0·08	Brande . .	4	–	Not determined.		Chl. 0·015		–	–	0·0002	0·0009	–
–	–	–	–	Brande . .	4	–	–	–	–	–	–	–	–	–	–
–	0·003	0·003	–	Millar . . .	1	–	–	–	–	–	–	–	–	–	–
–	0·005	0·006	–	Cooper . .	1	–	Not determined.		Chl. 0·014		–	–	0·001	0·004	–
–	0·005	0·006	–	Cooper . .	1	–	,,		Chl. 0·017		–	–	0·001	0·004	–
–	0·48	0·58	1·06	Way . . .	1	–	0·67	–	–	0·45	0·04	trace	0·11	0·15	0·16
–	–	–	–	Johnston . .	4	–	0·002	0·001	–	–	–	–	–	–	–
–	0·01	0·01	–	Herepath .	1	–	–	0·007	0·05		0·003	–	–	0·0015	–
–	–	–	–	Johnston . .	22	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Völcker . .	1			Salts 0·0016			–	–	–	?	?
–	–	–	–	Way . . .	1	–	–	–	–	0·002	–	–	–	–	–
–	–	–	–	Wilson . .	1	–	–	0·00006	Chl. 0·00029		–	–	0·00001	0·00005	–
–	–	–	–	Wilson . .	1	–	–	0·00008	Chl. 0·00023		–	–	0·00025	?	?
–	0·05	0·06	?	Way . . .	1	–	–	–	–	?	–	–	–	–	–
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Johnston . .	1	–		Salts 0·264			–	–	0·124	With salts.	–
–	–	–	–	Johnston . .	1	–		Salts 0·35			–	–	0·22	,,	–
–	–	–	–	Johnston . .	1	–	–	0·593	–	0·133	–	–	–	0·095	0·333

H 2.—LIQUID MANURES.

H 2.—LIQUID MANURES.

					General Division. In Natural State.					ENTIRE COMPOSITION PER CENT. Organic Matter. Ultimate Elements.								Inorganic Matter or Ash. Soluble in Rain-water. Abundantly.											
Class.	Species.				Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.	Magnesia.	Iron.	Phosph. Acid.	Sulph. Acid.	Carbonic Acid.
Farm Drainage		Manure	–	–	Johnston	1	99·3	0·39	0·39	Johnston	1	–	–	–	0·012	0·014	–	Johnston	1	–		Salts 0·302			–	–	–	With salts.	·
		Ditto, watered with cows' urine.	–	–	Johnston	1	98·1	1·14	0·74	Johnston	1	–	–	–	0·025	0·031	–	Johnston	1	–		Salts 0·[illegible]			–	–	–	,,	?
		Tank	–	–	Way	1	95·3	0·57	1·15	Way	1	–	–	–	0·423	0·512	–	Way	1	–	0·500	–	0·019	0·215	–	–	0·013	0·149	0·[illegible]
Urine	Man	–	–	–	Berzelius	1	93·3	4·78	1·92	– –	–	–	–	–	–	–	–	Berzelius	1	–	0·22	0·30	–	0·48	–	–	0·49?	0·17	?
		–	–	–	Lehmann	1	[illegible]	4·6[illegible]	[illegible]	Boussingault and Payen.	1	–	–	–	1·[illegible]	1·[illegible]	–	– –	–	–	–	–	–	–	–	–	–	–	–
	Horse	– –	–	–	Von Bibra	2	89·9	6·0	4·1	Boussingault and Payen.	1	–	–	–	1·26	1·52	–	Von Bibra	1	–	1·50	0·25	–	0·29	–	–	–	0·24	[illegible]
	Cow	–	–	–	Von Bibra	2	91·8	5·5	2·7	Boussingault and Payen.	1	–	–	–	0·31	0·38	–	Von Bibra	1	–	1·44	–	–	0·01	–	–	–	0·16	[illegible]
		– –	–	–	Sprengel	1	92·6	5·02	2·38	– –	–	–	–	–	–	–	–	Sprengel	1	–	0·60	0·55	Chl. 0·27		–	–	?	0·41	?
	Sheep	– –	–	–	Fromberg	1	92·9	5·10	2·00	Fromberg	1	–	–	–	0·59	0·71	–	Fromberg	1	–	0·032	0·568	0·240	0·610	–	–	?	0·114	0·[illegible]4
		– –	–	–	Sprengel	1	96·0	2·50	1·20	– –	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	
	Pig	– –	–	–	Sprengel	1	92·[illegible]	5·64	1·75	– –	–	–			–	–	–	Boussingault	1	–	0·[illegible]	–	–	0·[illegible]3	–	–	[illegible]	[illegible]	?
		– –	–	–	Von Bibra	2	88·2	0·84	0·96	– –	–	–	–	–	–	–	–	Von Bibra	1	–	0·08	0·12	–	0·51	–	–	?	0·04	?
Irrigation Water	Sewage-water	Clear	–	–	Brande	4	99·83	and alkalies 0·09	0·04	Brande	4	–	–	–	0·003	0·004	0·09	Brande	4	–	Not determined.		Chl. 0·015		–	–	0·0002	0·0009	–
		Deposit	–	–	Brande	4	99·92	0·03	0·05	– –	–	–	–	–	–	–	–	Brande	4	–	–	–	–	–	–	–	–	–	–
		?	–	–	Millar	1	99·93	0·01	0·06	Millar	1	–	–	–	0·003	0·003	–	Millar	1	–	–	–	–	–	–	–	–	–	–
		Clear	–	–	Cooper	1	99·89	0·11		Cooper	1	–	–	–	0·005	0·006	–	Cooper	1	–	Not determined.		Chl. 0·014		–	–	0·001	0·004	–
		Clear	–	–	Cooper	1	99·89	0·11		Cooper	1	–	–	–	0·005	0·006	–	Cooper	1	–	,,		Chl. 0·017		–	–	0·001	0·004	–
		– –	–	–	Way	1	93·00	4·30	2·70	Way	1	–	–	–	0·48	0·58	1·00	Way	1	–	0·67	–	–	0·45	0·04	trace	0·11	0·15	0·16
	Natural Waters	River	–	–	Johnston	4	99·98	0·003	0·022	– –	–	–	–	–	–	–	–	Johnston	4	–	0·009	0·001	–	–	–	–	–	–	–
			–	–	Herepath	1	95·0	0·3	4·7	Herepath	1	–	–	–	0·01	0·01	–	Herepath	1	–	–	0·007	0·05		0·003	–	–	0·0015	–
		Spring	–	–	Johnston	22	99·98	0·021		– –	–	–	–	–	–	–	–	Johnston	22	–	–	–	–	–	–	–	–	–	–
			–	–	Völcker	1	99·99	0·001	0·006	– –	–	–	–	–	–	–	–	Völcker	1		Salts 0·0018				–	–	–	?	
			–	–	Way	1	99·96	0·002	0·034	– –	–	–	–	–	–	–	–	Way	1	–	–	–	–	0·002	–	–	–	–	–
		Land drains	–	–	Wilson	1	100	0·0003	0·0008	– –	–	–	–	–	–	–	–	Wilson	1	–	–	0·[illegible]	Chl. [illegible]		–	–	0·00001	0·00005	–
			–	–	Wilson	1	100	0·0007	0·0014	– –	–	–	–	–	–	–	–	Wilson	1	–	–	0·00008	Chl. 0·00073		–	–	0·00025	?	?
Manufacturers' Refuse	Flax-water	– –	–	–	Way	1	93·63	2·59	3·78	Way	1	–	–	–	0·03	0·06	?	Way	1	–	–	–	–	?	–	–	–	–	–
	Gas Liquor	– –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
	Still refuse	Thin	–	–	Johnston	1	93·95	0·48	0·57	– –	–	–	–	–	–	–	–	Johnston	1	–		Salts 0·261			–	–	0·124	With salts.	
		Thick	–	–	Johnston	1	84·5	14·6	0·90	– –	–	–	–	–	–	–	–	Johnston	1	–		Salts 0·55			–	–	0·22	,,	–
	Spent Leys, Bleach-works.	– –	–	–	Johnston	1	96·0	0·81	1·19	– –	–	–	–	–	–	–	–	Johnston	1	–	–	0·593	–	0·133	–	–	–	0·095	0·321

H 2, *continued.*—LIQUID MANURES.

Class.	Species.		Authority.	Number of Analyses.	ENTIRE COMPOSITION … Inorgani… Soluble in Rain-water. Sparingly. Silica.	Lime.	Magnesia	Sulph. Acid.	Carbonic Acid.
Farm	Drainings	Manure	Johnston	1	?	0·015	0·003	—	0·014
		Ditto, watered with cows' urine.	Johnston	1	?	0·025	0·002	—	0·022
		Tank	Way	1	0·011	0·030	0·014	—	?
Urine.	Man	— —	Berzelius	1	0·004	0·04		—	?
		— —	— —	—	—	—	—	—	—
	Horse	— —	Von Bibra	1	0·02	0·29	0·18	—	1·20
	Cow	— —	Von Bibra	1	0·01	0·16	0·09	—	0·80
		— —	Sprengel	1	0·04	0·07	0·04	—	?
	Sheep	— —	Fromberg	1	0·022	0·010	0·004	—	0·012
		— —	— —	—	—	—	—	—	—
	Pig	— —	Boussingault	1	0·02	trace	0·14	—	0·15
		— —	Von Bibra	1	trace	0·04		—	0·04
Irrigation Water.	Sewage-water	Clear	Brande	4	0·009	0·011	—	—	0·001
		Deposit	Brande	4	—	—	—	—	—
		?	Millar	1	—	—	—	—	—
		Clear	Cooper	1	0·002	0·010	0·002	—	—
		Clear	Cooper	1	—	0·010	—	—	—
		— —	Way	1	0·02	0·11	—	—	—
	Natural Waters	River	Johnston	4	0·001	0·006	0·002	0·003	0·005
			Herepath	1	?	0·28	0·007	0·03	0·19
		Spring	Johnston	22	0·0014	—	—	—	—
			Völcker	1	0·0013	0·0011	0·0003	0·0012	0·0005
		Land drains	Way	1	0·004	0·015	0·0006	0·002	0·011
			Wilson	1	0·00008	0·00009	0·00002	—	—
			Wilson	1	0·00006	0·00029	0·00019	?	0·0001…
Manufacturers' Refuse.	Flax-water	— —	Way	1	—	—	?	—	—
	Gas liquor	— —	— —	—	—	—	—	—	—
	Still Refuse	Thin	Johnston	1	?	—	—	—	—
		Thick	Johnston	1	—	—	—	—	—
	Spent Leys, Bleach-works.	— —	Johnston	1	0·006	0·002	0·001	—	0·024

a. The Phosphates under Alumina and Oxide of Iron include Lime and Magnesia.——*b.* Average Warp.——*c.* Tho…
——*d.* The quantity of solid residue per cent. not being stated, I …

H 2, *continued.*—LIQUID MANURES.

PER CENT—*continued.*

Matter or Ash—*continued.*

Total Inorganic Matter.

Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
0·019	Salts 0·302		Phos. 0·037	Carb. 0·032	with silica	with phos.	–	with salts		with lime and mag.	with salts	with lime and mag.	
0·027	Salts 0·600		Phos. 0·064	Carb. 0·049	,,	,,	–	,,		,,	,,	,,	
0·017	0·500	–	0·030	0·014	–	0·020	–	0·049	0·215	0·013	0·149	0·142	
0·004	0·221	0·303	0·044		–	–	–	–	0·482	0·486	0·374	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	
0·02	1·59	0·25	0·29	0·18	–	trace	–	–	0·29	–	0·24	1·20	
0·01	1·44	–	0·16	0·09	–	,,	–	–	0·01	–	0·16	0·80	
0·04	0·66	0·55	0·07	0·04	0·006		–	Chl. 0·27		0·07	0·41	0·26	
0·022	0·032	0·568	0·010	0·004	Phos. 0·014		–	0·240	0·640	with lime and mag.	0·114	0·356	–a
–	–	–	–	–	–	–	–	–	–	–	–	–	
0·02	0·56	–	trace	0·14	–	–	–	–	0·43	0·15	0·30	0·15	
trace	0·08	0·12	0·04		–	trace	–	–	0·51	0·14	0·04	0·04	
0·009	with organic matter.		0·012	–	with silica	?	–	Chl. 0·015		0·002	0·0009	0·001	
0·032	–	–	0·007	–	,,	0·003	–	–	–	0·006	0·002	0·001	
0·0008	0·002	–	0·009	0·003	trace	trace	–	–	0·019	0·008	0·008	0·005	
0·002	Not determined		0·010	0·002	–	?	–	Chl. 0·014		0·001	0·004	?	
Not determined			0·010	?	?	?	–	Chl. 0·017		0·001	0·004	?	
0·46	0·68	0·02	0·34	0·04	0·09		–	–	0·47	0·15	0·21	0·22	
0·001	0·002	0·001	0·006	0·002	–	0·0007	–	–	with soda	–	0·003	0·005	
3·25	0·02	0·007	0·28	0·14	0·41	0·28	trace	0·05		0·02	0·04	0·19	–b
0·0014	–	–	–	–	–	–	–	–	–	–	–	–	
0·0013	salts 0·0016		0·0011	0·0003	–	–	–	–	with salts	–	0·0012	0·0005	–c
0·004	–	–	0·015	0·0006	–	–	–	–	0·002	–	0·002	0·011	
0·00008	–	0·00006	0·00009	0·00002	0·00004	0·00016	–	Chl. 0·00029		0·00001	0·00005	–	
0·00006	–	0·00008	0·00029	0·00019	0·00002	0·00018	–	Chl. 0·00023		0·00025	?	0·00010	
0·07	0·70	–	0·47	0·12	–	0·25	–	0·87	0·60	0·13	0·26	0·31	–d
–	–	–	–	–	–	–	–	–	–	–	–	–	
0·015	salts 0·264		0·069		–	–	–	with potash and soda		0·219	with potash & soda	–	
0·19	salts 0·35		0·06		–	–	–	with potash and soda		0·30	,,	–	
0·006	–	0·593	0·002	0·001	0·002		–	–	0·133	–	0·095	0·357	

iese quantities appear very minute they caused barren land in Aberdeenshire to bear a crop of Hay that weighed 4 tons
nable to calculate the entire composition of the Flax Steep Water.

H 2, *continued.*—LIQUID MANURES.

H 2, *continued.*—LIQUID MANURES.

ENTIRE COMPOSITION PER CENT—*continued.*

Inorganic Matter or Ash—*continued.*

Class.	Species.		Authority.	Number of Analyses.	Soluble in Rain-water, Sparingly: Silica.	Lime.	Magnesia.	Sulph. Acid.	Carbonic Acid.	Total Inorganic Matter: Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
Farm	Drainings	Manure	Johnston	1	?	0·015	0·003	–	0·014	0·019	Salts [illegible]		Phos. 0·047	Carb. 0·0[illegible]	with silica	with phos.	–	with salts		with lime and mag.	with salts	with lime and mag.	
		Ditto, watered with cows' urine.	Johnston	1	?	0·025	0·002	–	0·022	0·027	Salts 0·600		Phos. 0·004	Carb. 0·049	,,	,,	–	,,		,,	,,	,,	
		Tank	Way	1	0·011	0·030	0·014	–	?	0·017	0·500	–	0·030	0·014	–	0·020	–	0·049	0·215	0·013	0·149	[illegible]142	
Urine.	Man	– –	Berzelius	1	0·004	0·04		–	?	[illegible]	0·221	[illegible]	0·011		–	–	–	–	[illegible]	[illegible]	[illegible]	?	
		– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	Horse	– –	Von Bibra	1	0·02	0·29	0·18	–	1·20	[illegible]	[illegible]	[illegible]	[illegible]	0·18	–	trace	–	–	[illegible]	–	0·24	1·20	
	Cow	– –	Von Bibra	1	0·01	0·16	0·09	–	0·80	[illegible]	[illegible]	–	0·16	0·09	–	,,	–	–	[illegible]	–	0·15	[illegible]	
		– –	Sprengel	1	0·04	0·07	0·04	–	?	0·04	0·66	0·55	0·07	0·04	0·006		–	Chl 0·27		0·07	0·41	0·26	
	Sheep	– –	Fromberg	1	0·022	0·010	0·004	–	0·012	[illegible]	[illegible]	[illegible]	0·010	0·004	[illegible] 0·014		–	[illegible]	[illegible]	with lime and mag.	[illegible]	[illegible]	a
		– –	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	
	Pig	– –	Boussingault	1	0·02	trace	0·14	–	0·15	[illegible]	[illegible]	–	[illegible]	[illegible]	–	–	–	–	[illegible]	0·15	[illegible]	[illegible]	
		– –	Von Bibra	1	trace	0·04		–	0·04	trace	[illegible]	[illegible]	0·04		–	trace	–	–	[illegible]	0·11	[illegible]	[illegible]	
Irrigation Water.	Sewage-water	Clear	Brande	4	0·009	0·011	–	–	0·001	0·009	with organic matter.		[illegible]	–	with silica	?	–	Chl. 0·015		0·002	[illegible]	[illegible]	
		Depos't	Brande	4	–	–	–	–	–	0·002	–	–	[illegible]	–	,,	[illegible]	–	–	–	[illegible]	[illegible]	[illegible]	
		?	Millar	1	–	–	–	–	–	0·0008	0·002	–	[illegible]	[illegible]	trace	trace	–	–	[illegible]	[illegible]	[illegible]	[illegible]	
		Clear	Cooper	1	0·003	0·010	0·002	–	–	0·003	Not determined		[illegible]	[illegible]	–	?	–	Chl 0·014		[illegible]	[illegible]	?	
		Clear	Cooper	1	–	0·010	–	–	–	Not determined			[illegible]	?	?	?	–	Chl 0·017		[illegible]	[illegible]	?	
		– –	Way	1	0·02	0·11	–	–	–	0·45	0·69	[illegible]	[illegible]	0·04	[illegible]		–	–	0·47	[illegible]	0·21	[illegible]	
	Natural Waters	River	Johnston	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0·001	0·002	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	with soda	–	[illegible]	[illegible]	
			Herapath	1	?	0·28	0·007	0·03	0·19	3·25	0·02	0·007	[illegible]	0·11	0·41	[illegible]	[illegible]	[illegible]		0·02	[illegible]	[illegible]	b
		Spring	Johnston	22	0·0014	–	–	–	–	0·0014	–	–	–	–		–	–		–	–	–	–	
			Völcker	1	0·0013	0·0011	0·0003	0·0012	0·0005	0·0013	salts [illegible]		[illegible]	[illegible]	–	–	–	–	with salts	–	0·0012	[illegible]	c
			Way	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–	–	0·015	[illegible]	–	–	–	–	[illegible]		0·002	0·011	
		Land drains	Wilson	1	0·00009	0·00009	0·00002	–	–	0·00008	–	0·00006	0·00009	0·00002	0·00004	0·00016	–	Chl [illegible]		[illegible]	[illegible]	–	
			Wilson	1	0·00006	0·00029	0·00019	?	0·00010	0·00006	–	0·00008	0·00029	0·00019	0·00002	0·00016	–	Chl [illegible]		[illegible]	?	0·00010	
Manufacturers' Refuse.	Flax water	– –	Way	1	–	–	?	–	–	[illegible]	0·70	–	[illegible]	[illegible]	–	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	0·31	d
	Gas liquor	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	Still Refuse	Thin	Johnston	1	?	–	–	–	–	[illegible]	salts [illegible]		[illegible]		–	–	–	with potash and soda		[illegible]	with potash & soda	–	
		Thick	Johnston	–	–	–	–	–	–	[illegible]	salts [illegible]		[illegible]		–		–	with potash and soda		0·30	,,	–	
	Spent Leys, Bleach works	– –	Johnston	1	0·006	0·003	0·001	–	[illegible]	[illegible]	–	0·393	[illegible]	[illegible]	[illegible]		–	–	0·133	–	[illegible]	[illegible]	

a. The Phosphates under Alumina and Oxide of Iron include Lime and Magnesia.——*b.* Average Warp.——*c.* Though these quantities appear very minute they caused barren land in Aberdeenshire to bear a crop of Hay that weighed [illegible] tons.——*d.* The quantity of solid residue per cent. not being stated, I was unable to calculate the entire composition of the Flax Steep Water.

H 3.—LIQUID MANURES.

					General Division.					ENTIRE			
					In Natural State.					Organic			
										Ultimate			
Class.	Species.				Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.
Farm	Drainings . .	Manure .	–	–	Johnston . .	1	2224	7	9	Johnston . .	1	–	–
		Ditto, watered with cows' urine.	–	–	Johnston . .	1	2197	26	17	Johnston . .	1	–	–
		Tank . .	–	–	Way . . .	1	2201	13	26	Way . . .	1	–	–
Urine.	Man . . .	– –	–	–	Berzelius . .	1	2090	107	43	– –	–	–	–
		– –	–	–	Lehman . .	10	2097	104	39	Boussingault and Payen.	1	–	–
	Horse	– –	–	–	Von Bibra .	2	2014	134	92	Boussingault and Payen.	1	–	–
	Cow	– –	–	–	Von Bibra .	2	2056	123	61	Boussingault and Payen.	1	–	–
		– –	–	–	Sprengel . .	1	2074	113	53	– –	–	–	–
	Sheep . . .	– –	–	–	Fromberg .	1	2081	114	45	Fromberg .	1	–	–
		– –	–	–	Sprengel . .	1	2150	63	27	– –	–	–	–
	Pig	– –	–	–	Sprengel . .	1	2074	126	40	– –	–	–	–
		– –	–	–	Von Bibra .	2	2199	19	22	– –	–	–	–
Irrigation Water.	Sewage-water .	Clear . .	–	–	Brande . .	4	2237	and alkali 2	1	Brande . .	4	–	–
		Deposit .	–	–	Brande . .	4	2238	0·7	1·1	– –	–	–	–
		?	–	–	Millar . .	1	2238	0·2	1·4	Millar . . .	1	–	–
		Clear . .	–	–	Cooper . .	1	2237	2·5		Cooper . .	1	–	–
		Clear . .	–	–	Cooper . .	1	2237	2·5		Cooper . .	1	–	–
		– –	–	–	Way . . .	1	2083	96	61·0	Way . . .	1	–	–
	Natural Waters	River Warp.	–	–	Johnston . .	4	2239	0·07	0·49	– –	–	–	–
			–	–	Herepath .	1	2128	7	105	Herepath .	1	–	–
		Spring .	–	–	Johnston . .	22	2239	0·47		– –	–	–	–
			–	–	Völcker . .	1	2239·8	0·02	0·14	– –	–	–	–
		Land Drains.	–	–	Way . . .	1	2239	0·05	0·76	– –	–	–	–
			–	–	Wilson . .	1	2240	0·007	0·018	– –	–	–	–
			–	–	Wilson . .	1	2240	0·016	0·031	– –	–	–	–
Manufacturers' Refuse.	Flax-water . .	– –	–	–	Way . . .	1	2097	58	85	Way . . .	1	–	–
	Gas Liquor . .	– –	–	–	– –	–	–	–	–	– –	–	–	–
	Still Refuse .	Thin . .	–	–	Johnston . .	1	2104	123	13	– –	–	–	–
		Thick . .	–	–	Johnston . .	1	1893	327	20	– –	–	–	–
	Spent Leys, Bleach-works.	– –	–	–	Johnston . .	1	2195	19	26	– –	–	–	–

H 3.—LIQUID MANURES.

COMPOSITION PER TON, IN POUNDS.

Matter.				Inorganic Matter or Ash.											
Elements.							Soluble in Rain-water.								
							Abundantly.								
Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.
–	0·25	0·31	?	Johnston . .	1	–	salts 6·76				–	–	?	with salts.	?
–	0·56	0·69	?	Johnston . .	1	–	13·44				–	–	?	with salts.	?
–	9·47	11·46	?	Way . . .	1	–	11·20	–	1·10	4·82	–	–	0·29	3·34	3·18
–	–	–	–	Berzelius . .	1	–	4·95	6·79	–	10·80	–	–	10·89 ?	8·38	?
–	25·1	30·3	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	28·2	35·1	–	Von Bibra .	1	–	35·62	5·60	–	6·50	–	–	–	5·38	?
–	7·0	8·5	–	Von Bibra .	1	–	31·26	–	–	0·22	–	–	–	3·58	?
–	–	–	–	Sprengel . .	1	–	14·78	12·32	Chl. 6·05		–	–	?	9·18	?
–	13·2	15·9	–	Fromberg .	1	–	0·72	12·72	5·38	14·34	–	–	?	2·55	7·71
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Boussingault	1	–	12·54	–	–	9·63	–	–	?	6·72	?
–	–	–	–	Von Bibra .	1	–	1·79	2·69	–	11·42	–	–	?	0·90	?
–	0·07	0·09	and alkali 1·79	Brande . .	4	–	not determined		Chl. 0·34		–	–	0·005	0·02	–
–	–	–	–	Brande . .	4	–	–	–	–	–	–	–	–	–	–
–	0·06	0·07	?	Millar . .	1	–	–	–	–	–	–	–	–	–	–
–	0·11	0·13	?	Cooper . .	1	–	not determined		Chl. 0·31		–	–	?	?	?
–	0·11	0·13	?	Cooper . .	1	–	not determined		Chl. 0·38		–	–	?	?	?
–	10·7	12·9	23·7	Way . . .	1	–	15·0	–	–	10·0	0·9	trace	2·5	3·4	3·6
–	–	–	–	Johnston . .	4	–	0·04	0·02	–	with soda.	–	–	–	–	–
–	0·22	0·27	–	Herepath .	1	–	–	0·16	1·12		0·07	–	–	0·03	–
–	–	–	–	Johnston . .	22	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Völcker . .	1	–	salts 0·036				–	–	–	?	?
–	–	–	–	Way . . .	1	–	–	–	–	0·04	–	–	–	?	–
–	–	–	–	Wilson . .	1	–	–	0·0014	Chl. 0·0065		–	–	0·0002	0·0011	–
–	–	–	–	Wilson . .	1	–	–	0·0018	Chl. 0·0052		–	–	0·0056	?	?
–	1·12	1·36	–	Way . . .	1	–	–	–	–	?	–	–	–	–	–
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Johnston . .	1	–	salts 5·91				–	–	3·78	with salts.	?
–	–	–	–	Johnston . .	1	–	salts 7·84				–	–	4·92	with salts.	?
–	–	–	–	Johnston . .	1	–	–	13·28	–	2·98	–	–	–	2·13	7·46

H 3.—LIQUID MANURES.

H 3.—LIQUID MANURES.

COMPOSITION PER TON, IN POUNDS.

Class.	Species.				General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.
Farm	Drainings	Manure	–	–	Johnston	1	[illegible]	7	9	Johnston	1	–	–
		Ditto, watered with cows' urine.	–	–	Johnston	1	2197	26	17	Johnston	1	–	
		Tank	–	–	Way	1	2201	13	26	Way	1	–	–
Urine.	Man	— —	–	–	Berzelius	1	2090	107	43	— —	–	–	–
		— —	–	–	Lehmann	10	2097	[illegible]	[illegible]	Boussingault and Payen.	1	–	
	Horse	— —	–	–	Von Bibra	2	[illegible]	[illegible]	92	Boussingault and Payen.	1	–	–
	Cow	— —	–	–	Von Bibra	2	[illegible]	[illegible]	61	Boussingault and Payen.	1		–
		— —	–	–	Sprengel	1	2074	113	53	— —	–	–	–
	Sheep	— —	–	–	Fromberg	1	[illegible]	114	45	Fromberg	1	–	
		— —	–	–	Sprengel	1	2160	63	27	— —	–	–	–
	Pig	— —	–	–	Sprengel	1	2074	[illegible]	40	— —	–	–	–
		— —	–	–	Von Bibra	2	2199	19	22	— —	–	–	–
Irrigation Water.	Sewage-water	Clear	–	–	Brande	4	2237	and alkali 2	1	Brande	4	–	–
		Deposit	–	–	Brande	4	2238	0·7	1·1	— —	–	–	–
		?	–	–	Millar	1	2239	0·2	1·4	Millar	1	–	–
		Clear	–	–	Cooper	1	2237	2·5		Cooper	1	–	–
		Clear	–	–	Cooper	1	2237	2·5		Cooper	1	–	–
		— —	–	–	Way	1	[illegible]	[illegible]	[illegible]	Way			–
	Natural Waters	River Warp.		–	Johnston	4	[illegible]	0·07	0·47	— —	–	–	
			–	–	Herepath	1	2128	7	105	Herepath	1	–	–
		Spring	–	–	Johnston	22	2239	0·47		— —	–	–	–
			–	–	Völcker	1	2239·8	0·02	0·14	— —	–	–	–
			–	–	Way	1	2239	0·05	0·76	— —	–	–	–
		Land Drains.	–	–	Wilson	1	2240	0·007	0·018	— —	–	–	–
			–	–	Wilson	1	[illegible]	0·016	[illegible]	— —	–	–	
Manufacturers' Refuse.	Flax water	— —	–	–	Way	1	2097	58	85	Way	1	–	–
	Gas Liquor	— —	–	–	— —	–	–	–	–	— —	–	–	–
	Still Refuse	Thin	–	–	Johnston	1	2104	123	13	— —	–	–	–
		Thick	–	–	Johnston	1	1893	327	20	— —	–	–	–
	Spent Leys, Bleach-works	— —	–	–	Johnston	1	2195	19	28	— —	–	–	–

Species.		Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic Matter or Ash. Authority.	Number of Analyses.	Total Sulphur.	Soluble in Rain-water. Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.	Magnesia.	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.
Drainings	Manure	–	0·45	0·31	?	Johnston	1	–	salts 6·76				–	–	?	with salts.	?
	Ditto, watered with cows' urine.	–	0·56	0·69	?	Johnston	1	–	13·44				–	–	?	with salts.	?
	Tank	–	9·47	11·40	?	Way	1	–	11·20	–	1·10	4·82	–	–	0·29	3·34	3·18
Man		–	–	–	–	Berzelius	1	–	4·95	6·79	–	10·80	–	–	10·69 ?	6·38	?
		–	25·1	30·3	–	— —	–	–	–	–	–	–	–	–	–	–	–
Horse		–	[illegible]	[illegible]	–	Von Bibra	1		35·62	5·60	–	6·50	–	–	–	5·38	?
Cow		–	7·0	8·5	–	Von Bibra	1	–	31·29	–	–	[illegible]	–	–	–	[illegible]	?
		–	–	–	–	Sprengel	1	–	14·78	12·32	Chl. 6·05		–	–	?	9·18	?
Sheep		–	13·3	15·9	–	Fromberg	1	–	0·72	12·72	5·34	14·34	–	-	?	2·55	7·71
		–	–	–	–	— —	–	–	–	–	–	–	–	–	–	–	–
Pig		–	–	–	–	Boussingault	1	–	12·54	–	–	9·63	–	–	?	6·72	?
		–	–	–	–	Von Bibra	1	–	1·79	2·69	–	11·42	–	–	?	0·90	?
Sewage-water	Clear	–	0·07	0·09	and alkali 1·79	Brande	4	–	not determined		Chl. 0·34		–	–	0·005	0·03	–
	Deposit	–	–	–	–	Brande	4	–	–	–	–	–	–	–	–	–	–
	?	–	0·06	0·07	?	Millar	1	–	–	–	–	–	–	–	–	–	–
	Clear	–	0·11	0·13	?	Cooper	1	–	not determined		Chl. 0·31		–	–	?	?	?
	Clear	–	0·11	0·13	?	Cooper	1	–	not determined		Chl. 0·38		–	–	?	?	?
	— —		10·7	12·9	23·7	Way	1	-	15·0	-	–	10·0	0·9	trace	[illegible]	3·4	3·6
Natural Waters	River Warp.	–	–	–	–	Johnston	4	–	0·04	0·02	–	with soda.	–	–	–	–	–
		–	0·22	0·27	–	Herepath	1	–	–	0·16	1·12		0·07	–	–	0·03	–
	Spring	–	–	–	–	Johnston	22	–	–	–	–	–	–	–	–	–	–
		–	–	–	–	Völcker	1	–	salts 0·036				–	–	–	?	?
		–	–	–	–	Way	1	–	–	–	–	0·04	–	–	–	?	–
	Land Drains.	–	–	–	–	Wilson	1	–	–	0·0014	Chl. 0·0065		–	–	0·0002	0·0011	–
		–	–	–	–	Wilson	1	–	–	0·0018	Chl. [illegible]		–	–	[illegible]	?	?
Flax water		–	1·12	1·36	–	Way	1	–	–	–	–	?	–	–	–	–	–
Gas Liquor		–	–	–	–	— —	–	–	–	–	–	–	–	–	–	–	–
Still Refuse	Thin	–	–	–	–	Johnston	1	–	salts 5·91				–	–	3·78	with salts.	?
	Thick	–	–	–	–	Johnston	1	–	salts 7·84				–	–	4·93	with salts.	?
Spent Leys, Bleach-works		–	–	–	–	Johnston	1	–	–	13·26	–	2·96	–	–	–	2·13	7·46

H 3, *continued.*—LIQUID MANURES.

Class.	Species.		Authority.	Number of Analyses.	ENTIRE COMPOSITION — Inorganic — Soluble in Rain-water. — Sparingly. — Silica.	Lime.	Magnesia.	Sulph. Acid.	Carbonic Acid.
Farm	Drainings . . .	Manure . . .	Johnston . . .	1	?	0·34	0·07	–	0·31
		Ditto, watered with cows' urine.	Johnston . . .	1	?	0·56	0·05	–	0·49
		Tank	Way	1	0·38	0·67	0·31	–	?
Urine.	Man	– –	Berzelius . . .	1	0·09	0·99		–	–
		– –	– –	–	–	–	–	–	–
	Horse	– –	Von Bibra . .	1	0·45	6·50	4·03	–	26·88
	Cow	– –	Von Bibra . .	1	0·22	3·58	2·02	–	17·92
		– –	Sprengel . . .	1	0·90	1·57	0·90	–	5·82
	Sheep	– –	Fromberg . . .	1	0·49	0·22	0·09	–	0·27
		– –	– –	–	–	–	–	–	–
	Pig	– –	Boussingault . .	1	0·45	trace	3·14	–	3·36
		– –	Von Bibra . .	1	trace	0·90		–	0·90
Irrigation-Water.	Sewage-water .	Clear	Brande	4	0·20	0·25	–	–	0·02
		Deposit . . .	Brande	4	–	–	–	–	–
		?	Millar	1	–	–	–	–	–
		Clear	Cooper	1	0·04	0·22	0·05	0·09	?
		Clear	Cooper	1	?	0·22	?	0·09	?
		– –	Way	1	0·4	2·5	–	–	–
	Natural Waters	River Warp .	Johnston . . .	4	0·02	0·14	0·05	0·07	0·11
			Herepath . . .	1	?	6·27	0·16	0·67	4·25
		Spring . . .	Johnston . . .	22	0·03	–	–	–	–
			Völcker . . .	1	0·029	0·025	0·007	0·027	0·011
		Land Drains .	Way.	1	0·09	0·34	0·01	0·04	0·25
			Wilson	1	0·0018	0·0020	0·0005	–	–
			Wilson	1	0·0014	0·0065	0·0043	–	0·0022
Manufacturer' Refuse.	Flax-water . . .	– –	Way.	1	–	–	?	–	–
	Gas Liquor . . .	– –	– –	–	–	–	–	–	–
	Still Refuse . .	Thin	Johnston . . .	1	?	1·55		–	?
		Thick	Johnston . . .	1	?	1·34		–	?
	Spent Leys, Bleach-works.	– –	Johnston . . .	1	0·13	0·05	0·02	–	0·54

H 3, *continued.*—LIQUID MANURES.

PER TON, IN POUNDS—*continued.*

Matter or Ash—*continued.*

Total Inorganic Matter.

Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
0·43	salts 6·76		phos. 0·83	carb. 0·72	with silica.	with phos.	–	with salts		with lime and mag.	with salts.	with lime and mag.
0·61	salts 13·44		phos. 1·43	carb. 1·10	with silica.	with phos.	–	with salts		with lime and mag.	with salts.	with lime and mag.
0·38	11·20	–	0·67	0·31	–	0·45	–	1·10	4·82	0·29	3·34	3·18
0·09	4·95	6·79	0·99		–	–	–	–	10·80	10·89	8·38	?
–	–	–	–	–	–	–	–	–	–	–	–	–
0·45	35·62	5·60	6·50	4·03	–	trace	–	–	6·50	–	5·38	26·88
0·22	31·26	–	3·58	2·02	–	trace	–	–	0·22	–	3·58	17·92
0·90	14·78	12·32	1·57	0·90	0·14		–	Chl. 6·05		1·57	9·18	5·82
0·49	0·72	12·72	0·22	0·09	phos. 0·31		–	5·38	14·34	with lime and mag.	2·55	7·98
–	–	–	–	–	–	–	–	–	–	–	–	–
0·45	12·54	–	trace	3·14	–	–	–	–	9·63	3·36	6·72	3·36
trace	1·79	2·69	0·90		–	trace	–	–	11·42	3·14	0·90	0·90
0·20	with org. matter		0·27	–	with silica.	–	–	Chl. 0·34		0·05	0·02	0·02
0·72	–	–	0·16	–	with silica.	0·07	–	–	–	0·13	0·04	0·02
0·02	0·05	–	0·20	0·07	trace	trace	–	–	0·43	0·18	0·18	0·11
0·04	not determined		0·22	0·05	?	?	?	Chl. 0·31		0·02	0·09	?
not determined			0·22	?	?	?	?	Chl. 0·38		0·02	0·09	?
10·3	15·2	0·4	7·6	0·9	2·0		–	–	10·5	3·4	4·7	4·9
0·02	0·04	0·02	0·14	0·05	–	0·02	–	–	with soda.	–	0·07	0·11
72·8	0·45	0·16	6·27	3·13	9·18	6·27	trace	1·12		0·45	0·90	4·25
0·03	–	–	–	–	–	–	–	–	–	–	–	–
0·029	salts 0·036		0·025	0·007	–	–	–	–	with salts.	–	0·027	0·011
0·09	–	–	0·34	0·01	–	–	–	–	0·04	–	0·04	0·25
0·0018	–	0·0014	0·0020	0·0005	0·0009	0·0036	–	Chl. 0·0065		0·0002	0·0011	–
0·0014	–	0·0018	0·0065	0·0043	0·0005	0·0040	–	Chl. 0·0052		0·0056	?	0·0022
1·57	15·68	–	10·53	2·69	–	5·60	–	19·49	13·44	2·91	5·82	6·94
–	–	–	–	–	–	–	–	–	–	–	–	–
0·34	salts 5·91		1·55		–	–	–	with salts		4·91	with salts.	?
4·26	salts 7·84		1·34		–	–	–	with salts		6·72	with salts.	?
0·13	–	13·28	0·05	0·02	0·04		–	–	2·98	–	2·13	8·00

H 4.—LIQUID MANURES.

Class.	Species.				General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE Organic Ultimate Authority.	Number of Analyses.	Carbon.	Hydrogen.
Farm.	Drainings	Manure	–	–	Johnston	1	9931	30	39	Johnston	1	–	–
		Ditto watered with Cows' urine.	–	–	Johnston	1	9812	114	74	Johnston	1	–	–
		Tank	–	–	Way	1	9828	57	115	Way	1	–	–
Urine.	Man	– –	–	–	Berzelius	1	9330	478	192	– –	–	–	–
		– –	–	–	Lehman	10	9360	465	175	Boussingault and Payen.	1	–	–
	Horse	– –	–	–	Von Bibra	2	8990	600	410	Boussingault and Payen.	1	–	–
	Cow	– –	–	–	Von Bibra	2	9180	550	270	Boussingault and Payen.	1	–	–
		– –	–	–	Sprengel	1	9260	502	238	– –	–	–	–
	Sheep	– –	–	–	Fromberg	1	9290	510	200	Fromberg	1	–	–
		– –	–	–	Sprengel	1	9600	280	120	– –	–	–	–
	Pig	– –	–	–	Sprengel	1	9260	564	176	– –	–	–	–
		– –	–	–	Von Bibra	2	9820	84	96	– –	–	–	–
Irrigation-Water.	Sewage Water	Clear	–	–	Brande	4	9988	and Alkali 8	4	Brande	4	–	–
		Deposit	–	–	Brande	4	9992	3	5	– –	–	–	–
		?	–	–	Millar	1	9993	1	6	Millar	1	–	–
		Clear	–	–	Cooper	1	9989	11		Cooper	1	–	–
		Clear	–	–	Cooper	1	9989	11		Cooper	1	–	–
		– –	–	–	Way	1	9300	430	270	Way	1	–	–
	Natural Waters	River	–	–	Johnston	4	9997	0·3	2·2	– –	–	–	–
			Warp		Herepath	1	9500	30	470	Herepath	1	–	–
		Spring	–	–	Johnston	22	9998	2·1		– –	–	–	–
			–	–	Völcker	1	9999	0·1	0·6	– –	–	–	–
			–	–	Way	1	9996	0·2	3·4	– –	–	–	–
		Land Drains	–	–	Wilson	1	9999·9	0·03	0·08	– –	–	–	–
			–	–	Wilson	1	9999·8	0·07	0·14	– –	–	–	–
Manufacturers' Refuse.	Flax water	– –	–	–	Way	1	9363	259	378	Way	1	–	–
	Gas Liquor	– –	–	–	– –	–	–	–	–	– –	–	–	–
	Still Refuse	Thin	–	–	Johnston	1	9395	548	57	– –	–	–	–
		Thick	–	–	Johnston	1	8450	1460	90	– –	–	–	–
	Spent Leys, Bleach Works.	– –	–	–	Johnston	1	9797	84	119	– –	–	–	–

H 4.—LIQUID MANURES.

COMPOSITION PER 1000 GALLONS IN POUNDS.															
Matter.					Inorganic Matter or Ash.										
Elements.							Soluble in Rain Water.								
							Abundantly.								
Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chloride of Potassium.	Chloride of Sodium.	Magnesia	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.
–	1·2	1·4	–	Johnston . .	1	–	Salts. 30·2				–	–	?	with Salts.	?
–	2·5	3·1	–	Johnston . .	1	–	Salts. 60·0				–	–	?	with Salts.	?
–	42·3	51·2	–	Way . . .	1	–	50·0	–	4·9	21·5	–	–	1·3	14·9	14·2
–	–	–	–	Berzelius . .	1	–	22·6	30·8	–	48·2	–	–	48·6	37·4	?
–	112·0	135·5	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	126·0	152·0	–	Von Bibra .	1	–	159·0	25·0	–	29·0	–	–	–	24·0	?
–	31·0	37·5	–	Von Bibra .	1	–	144·0	–	–	1·0	–	–	–	16·0	?
–	–	–	–	Sprengel . .	1	–	66·0	55·0	Chl. 27·0		–	–	?	41·0	?
–	59·0	71·0	–	Fromberg .	1	–	3·2	56·8	24·0	64·0	–	–	?	11·4	34·4
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Boussingault	1	–	56·0	–	–	43·0	–	–	?	30·0	?
–	–	–	–	Von Bibra .	1	–	8·0	12·0	–	51·0	–	–	?	4·0	?
–	–	–	8	Brande . .	4	–	not determined		Chl. 1·5		–	–	0·02	0·09	–
–	–	–	–	Brande . .	4	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Millar . . .	1	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Cooper . .	1	–	not determined		Chl. 1·4		–	–	0·1	0·4	–
–	–	–	–	Cooper . .	1	–	not determined		Chl. 1·7		–	–	0·1	0·4	–
–	48	58	106	Way . . .	1	–	67·0	–	–	45·0	4·0	trace	11·0	15·0	16·0
–	–	–	–	Johnston . .	4	–	0·2	0·1	–	–	–	–	–	–	–
–	1·0	1·2	–	Herepath .	1	–	–	0·7	5·0		0·3	–	–	0·15	–
–	–	–	–	Johnston . .	22	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Völcker . .	1	–	Salts. 0·16				–	–	–	?	?
–	–	–	–	Way . . .	1	–	–	–	–	0·2	–	–	–	–	–
–	–	–	–	Wilson . .	1	–	–	0·006	Chl. 0·029		–	–	0·001	0·005	–
–	–	–	–	Wilson . .	1	–	–	0·008	Chl. 0·023		–	–	0·025	?	?
–	5	6·0	?	Way . . .	1	–	–	–	–	?	–	–	–	–	–
–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Johnston . .	1	–	Salts. 26·4				–	–	12·4	with Salts.	–
–	–	–	–	Johnston . .	1	–	Salts. 35·0				–	–	22·0	with Salts.	–
–	–	–	–	Johnston . .	1	–	–	59·3	–	13·3	–	–	–	9·5	33·3

H 4, *continued.*—LIQUID MANURES.

Class.	Species.		Authority.	Number of Analyses.	ENTIRE — Inorganic — Soluble in Rain Water. — Sparingly. Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.
Farm.	Drainings . . .	Manure . . .	Johnston . . .	1	?	1·5	0·3	–	1·4
		Ditto watered with Cows' urine.	Johnston . . .	1	?	2·5	0·2	–	2·2
		Tank	Way	1	1·1	3·0	1·4	–	?
Urine.	Man	– –	Berzelius . . .	1	0·4	4·4		–	?
		– –	– –	–	–	–	–	–	–
	Horse	– –	Von Bibra . .	1	2·0	29·0	18·0	–	120·0
	Cow	– –	Von Bibra . .	1	1·0	16·0	9·0	–	80·0
		– –	Sprengel . . .	1	4·0	7·0	4·0	–	26·0
	Sheep	– –	Fromberg . . .	1	2·2	1·0	0·4	–	1·2
		– –	– –	–		–	–	–	–
	Pig	– –	Boussingault . .	1	2·0	trace	14·0	–	15·0
		– –	Von Bibra . .	1	trace	4·0		–	4·0
Irrigation Water.	Sewage Water . .	Clear	Brande . . .	4	0·9	1·1	–	–	0·1
		Deposit . . .	Brande. . . .	4	–	–	–	–	–
		?	Millar	1	–	–	–	–	–
		Clear	Cooper	1	0·2	1·0	0·2	–	–
		Clear	Cooper	1	–	1·0	–	–	–
		– –	Way	1	2·0	11·0	–	–	–
	Natural Waters . .	River	Johnston . . .	4	0·1	0·6	0·2	0·3	0·5
			Herepath . . .	1	?	28·0	0·7	3·0	19·0
		Spring . . .	Johnston . . .	22	0·14	–	–	–	–
			Völcker . . .	1	0·13	0·11	0·03	0·12	0·05
		Land Drains .	Way	1	0·4	1·5	0·06	0·2	1·1
			Wilson	1	0·008	0·009	0·002	–	–
			Wilson	1	0·006	0·029	0·019	?	0·010
Manufacturers' Refuse.	Flax Water . . .	– –	Way.	1	–	–	?	–	–
	Gas Liquor . . .	– –	– –	–	–	–	–	–	–
	Still Refuse . . .	Thin	Johnston . . .	1	?	–	–	–	–
		Thick	Johnston . . .	1	?	–	–	–	–
	Spent Leys, Bleach Works.	– –	Johnston . . .	1	0·6	0·2	0·1	–	2·4

a. As I had no means of ascertaining the quantity usually applied to one acre, I have altered the form of this part of their liquid manure in gallons, can

H 4, *continued.*—LIQUID MANURES.

COMPOSITION PER 1000 GALLONS IN POUNDS—*continued.*

Matter or Ash—*continued.*

Total Inorganic Matter.

Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
1·9	Salts. 30·2		Phos. 3·7	Carbon. 3·2	with Silica.	with Phos.	–	with Salts.		with Lime and Mag.	with Salts.	with Lime and Mag.
2·7	Salts. 60·0		Phos. 6·4	Carbon. 4·9	with Silica.	with Phos.	–	with Salts.		with Lime and Mag.	with Salts.	with Lime and Mag.
1·7	50·0	–	3·0	1·4	–	2·0	–	4·9	21·5	1·3	14·9	14·2
0·4	22·1	30·3	4·4		–	–	–	–	48·2	48·6	37·4	?
–	–	–	–	–	–	–	–	–	–	–	–	–
2·0	159·0	25·0	29·0	18·0	–	trace	–	–	29·0	–	24·0	120·0
1·0	144·0	–	16·0	9·0	–	trace	–	–	1·0	–	16·0	80·0
4·0	66·0	55·0	7·0	4·0	0·6		–	Chl. 27·0		7·0	41·0	26·0
2·2	3·2	56·8	1·0	0·4	Phos. 1·4		–	24·0	64·0	with Lime and Mag.	11·4	35·6
–	–	–	–	–	–	–	–	–	–		–	–
2·0	56·0	–	trace	14·0	–	–	–	–	43·0	15·0	30·0	15·0
trace	8·0	12·0	4·0		–	trace	–	–	51·0	14·0	4·0	4·0
0·9	with Organic Matter.		1·2	–	with Silica.	?	–	Chl. 1·5		0·2	0·09	0·1
3·2	–	–	0·7	–	with Silica.	0·3	–	–	–	0·6	0·2	0·1
0·08	0·2	–	0·9	0·3	trace	trace	–	–	1·9	0·8	0·8	0·5
0·2	not determined.		1·0	0·2	?	?	–	Chl. 1·4		0·1	0·4	?
not determined.			1·0	?	?	?	–	Chl. 1·7		0·1	0·4	?
46·0	68·0	2·0	34·0	4·0	9·0		–	–	47·0	15·0	21·0	22·0
0·1	0·2	0·1	0·6	0·2	–	0·07	–	–	with Soda.	–	0·3	0·5
325·0	2·0	0·7	28·0	14·0	41·0	28·0	trace	5·0		2·0	4·0	19·0
0·14	–	–	–	–	–	–	–	–	–	–	–	–
0·13	Salts 0·16		0·11	0·03	–	–	–	–	with Salts.	–	0·12	0·05
0·4	–	–	1·5	0·06	–	–	–	–	0·2	–	0·2	1·1
0·008	–	0·006	0·009	0·002	0·004	0·016	–	Chl. 0·029		0·001	0·005	–
0·006	–	0·008	0·029	0·019	0·002	0·018	–	Chl. 0·023		0·025	?	0·010
7	70	–	47	12	–	25	–	87	60	13	26	31
–	–	–	–	–	–	–	–	–	–	–	–	–
1·5	Salts. 26·4		6·9		–	–	–	with Potash and Soda.		21·9	with Salts.	–
19·0	Salts. 35·0		6·0		–	–	–	with Salts.		30·0	with Salts.	–
0·6	–	59·3	0·2	0·1	0·2		–	–	13·3	–	9·5	35·7

the table, and calculated the amount contained in 1000 gallons, so that those persons who are accustomed to estimate easily calculate its composition.

I 1.—ARTICLES USED IN FEEDING.

Class.	Species.	Parts.	Proportion per Cent. dry.		General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF EACH — Organic or — Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Proximate — Ammonia.	Azotised. Authority.	Number of Anal.
Oilcakes.	Linseed	English	–	–	Fromberg	1	–	91·9	8·06	Way . .	11	–	–	–	5·56	6·73	Fromberg	1
			–	–	Nesbit .	2	–	93·8	6·23	Nesbit .	2	–	–	–	6·21	7·51	Way . .	11
			–	–	Way . .	9	–	92·1	7·95	Way . .	9	–	–	–	5·43	6·57	Way . .	9
		American.	–	–	Fromberg	1	–	92·9	7·06	– –	–	–	–	–	–	–	Fromberg	1
			–	–	Lawes .	3	–	93·6	6·38	Lawes .	3	–	–	–	6·14	7·43	– –	–
			–	–	Way . .	7	–	93·1	6·87	Way . .	7	–	–	–	5·55	6·71	Way . .	7
		Dutch, &c.	French		Nesbit .	1	–	94·0	6·02	Nesbit .	1	–	–	–	6·45	7·80	– –	–
			French		Way . .	8	–	87·7	12·34	Way . .	8	–	–	–	5·83	7·05	Way . .	8
			Dutch, &c.		Way . .	3	–	89·6	10·39	Way . .	3	–	–	–	5·64	6·82	Way . .	3
	Gold of Pleasure.	Dutch .	–	–	Fromberg	1	–	92·3	7·66	– –	–	–	–	–	–	–	Fromberg	1
	Rape . .	Dutch	–	–	Nesbit .	1	–	86·6	13·40	Nesbit .	1	–	–	–	6·52	7·89	Way . .	1
			–	–	Way . .	2	–	91·4	8·60	Way . .	1	–	–	–	6·14	7·43	Way . .	2
Corn.	Barley	Malt	87·0	–	Thomson	2	–	98·5	1·52	Thomson	2	45·0	7·1	46·3	1·57	1·90	Thomson	1
			90·2	–	Lawes .	2	–	97·4	2·63	Lawes .	2	–	–	–	1·68	2·03	Proust .	1
		Malt Dust.	4·0	–	Lawes .	1	–	90·7	9·27	Lawes .	1	–	–	–	4·82	5·83	– –	–
		Brewers' Grains.	–	–	Johnston	1	–	95·1	4·92	– –	–	–	–	–	–	–	Johnston	1
		Distillers' Refuse.	–	1st	Johnston	1	–	90·6	9·39	– –	–	–	–	–	–	–	Johnston	1
			–	2nd	Johnston	1	–	94·2	5·80	– –	–	–	–	–	–	–	Johnston	1
	Maize . .	Grain .	–	–	Payen .	1	–	98·8	1·20	Johnston	1	–	–	–	2·10	2·50	Payen .	1
	Dhoora . .	Grain .	–	–	Johnston	1	–	100	?	– –	–	–	–	–	–	–	Johnston	1
	Wheat . .	Bran .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Oat . . .	Meal	–	–	Norton .	2	–	97·7	2·29	Norton .	9	–	–	–	3·00	3·63	Norton .	2
			–	–	Fromberg	2	–	98·1	1·89	– –	–	–	–	–	–	–	Fromberg	2
	Rye . . .	Meal .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Barley . .	Meal .	–	–	Playfair .	1	–	97·6	2·37	– –	–	–	–	–	–	–	Einhof .	1
	Maize . .	Meal .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Bulbs, Tubers, & Fruit.	Turnip . .	Meal .	–	–	Johnston	1	–	94·5	5·53	– –	–	–	–	–	–	–	Johnston	1
	Plantain .	Meal .	–	–	Johnston	3	–	97·3	2·71	– –	–	–	–	–	–	–	Johnston	3
	Carob Bean	Fruit .	–	–	Johnston	1	–	100		– –	–	–	–	–	–	–	Johnston	1
	Water Yam	Tuber .	–	–	Johnston	1	–	100		– –	–	–	–	–	–	–	Johnston	1
	Guinea Yam	Tuber .	–	–	Johnston	1	–	100		– –	–	–	–	–	–	–	Johnston	1
	Sweet Potato	Tuber .	–	–	Johnston	1	–	100		– –	–	–	–	–	–	–	Johnston	1

a. See proximate Analyses of Linseed.——*b*. The quantities given under the Proportion column refer to Barley as 100, from that the amount of Phosphoric Acid in the earthy

I 1.—ARTICLES USED IN FEEDING.

PORTION PER CENT.																								
Combustible Matter.									Inorganic Matter or Ash.															
Elements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
	26·8		14·4	–	47·3	–	11·5	Fromberg	1	–	14·7	–	–	–	–	–	–	–	–	–	–	–	–	–a
–	–	–	13·2	–	–	–	–	Nesbit .	2	–	–	–	–	–	–	–	–	–	–	–	31·9	–	–	
–	–	–	16·1	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	26·6		14·8	–	43·4	–	15·2	Fromberg	1	–	4·1	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	13·3	–	–	–	–	Way . .	2	–	10·9	23·9	0·7	8·4	15·3	–	2·9	–	–	1·5	30·7	3·8	3·8	
–	–	–	–	–	–	–	–	Nesbit .	1	–	–	–	–	–	–	–	–	–	–	–	30·5	–	–	
–	–	–	11·2	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	11·7	–	–	–	–	Way . .	2	–	26·7	19·5	0·7	6·6	12·4	–	1·5	–	–	0·6	30·2	1·5	0·2	
	30·7		14·9	–	42·2	–	12·2	Fromberg	1	–	24·5	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	13·4	–	–	–	–	Nesbit .	1	–	–	–	–	–	–	–	–	–	–	–	15·9	–	–	
–	–	–	13·0	–	–	–	–	Way . .	1	–	13·1	21·9	–	8·6	14·7	–	4·5	–	0·2	0·5	32·7	1·6	2·2	
	1·0		–	69·0	14·0	16·0	?	Thomson	1	–	28·7	11·7	6·0	3·8	9·8	–	1·6	–	trace		38·3	–	–	-b
	1·0		–	68·0	16·0	15·0	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	2·7		–	–	4·7	–	92·6	Johnston	1	–	41·5	–	–	–	–	–	–	–	–	–	–	–	–	
	?		–	?	?	?	–	Johnston	1	–	2·6	46·3		12·1		–	–	–	with Potash and Soda.		38·5	with Potash and Soda.	–	–c
	?		–	?	?	?	–	Johnston	1	–	21·0	38·4		6·7		–	–	–	with Potash and Soda.		33·6	,,	–	
	12·5		9·1	72·1	0·4		5·9	Sprengel	1	–	33·1	15·2	19·1	2·6	9·7	1·2	trace	–	Chlorides. 0·6		17·1	1·3	–	
7·3		5·4	–	78·4	1·4	2·1	5·4	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
1·3	2·0	16·4	6·6	67·0	2·2	2·7	1·8	Norton .	1	–	1·9	31·6		5·3	8·7	–	0·9	–	–	0·4	49·2	–	–	
1·5	1·4	17·3	6·8	66·1	2·3	1·9	2·7	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
1·3	4·4	?	?	82·2	5·7	6·4	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	18·8		1·5	–	5·7	62·9	11·1	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	5·3		0·5	80·6	5·4	2·4	5·8	Völcker .	1	–	1·9	37·4	2·2	0·4	7·4	–	0·4	–	–	25·0	7·7	2·8	15·6	
	4·3		0·4	with fibre	5·8	60·4	29·1	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
0·7	–	7·6	?	68·7	1·0	11·2	10·8	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
2·8	–	6·9	–	69·3	0·8	13·8	6·4	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
trace	–	6·5	–	40·9	1·4	19·7	31·5	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

the numbers being opposite to the authorities.——*c*. I have taken the Lime as double the Magnesia and calculated Phosphates—the remainder being given by Professor Johnston.

12.—ARTICLES USED IN FEEDING.

Class.	Species.	Parts.	Proportion per Cent.	Grains in Gallon.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic or… Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate… Azotised… Authority.	Number of Anal.
Oilcakes.	Linseed	English	–	–	Fromberg	1	10·1	82·7	7·25	Way . .	11	–	–	–	4·60	5·57	Fromberg	1
			–	–	Nesbit .	2	12·7	81·9	5·44	Nesbit .	2	–	–	–	5·09	6·16	Way . .	11
			–	–	Way . .	9	8·6	84·1	7·27	Way . .	9	–	–	–	4·57	5·53	Way . .	9
		American	–	–	Fromberg	1	10·1	83·6	6·35	– –	–	–	–	–	–	–	Fromberg	1
			–	–	Lawes .	3	11·1	83·2	5·67	Lawes .	3	–	–	–	5·12	6·20	– –	–
				–	Way . .	7	7·6	86·1	6·35	Way . .	7	–	–	–	4·74	5·74	Way . .	7
		Dutch, &c.	French		Nesbit .	1	12·4	81·8	5·76	Nesbit .	1	–	–	–	5·28	6·39	– –	–
			French		Way . .	8	7·6	81·0	11·40	Way . .	8	–	–	–	4·72	5·71	Way . .	8
			Dutch, &c.		Way . .	3	8·0	82·4	9·56	Way . .	3	–	–	–	4·65	5·63	Way . .	3
	Gold of Pleasure.	Dutch –	–	–	Fromberg	1	9·9	83·2	6·89	– –	–	–	–	–	–	–	Fromberg	1
	Rape –	Dutch	–	–	Nesbit .	1	8·7	79·0	12·26	Nesbit .	1	–	–	–	5·15	6·23	Way . .	1
			–	–	Way . .	2	6·8	85·2	8·00	Way . .	1	–	–	–	5·23	6·33	Way . .	2
Corn.	Barley –	Malt –	81·0	–	Thomson	2	7·0	91·6	1·41	Thomson	2	41·2	6·5	42·4	1·37	1·66	Thomson	1
			77·4	–	Lawes .	2	6·5	91·0	2·46	Lawes .	2	–	–	–	1·57	1·90	Proust .	1
		Malt Dust	3·5	–	Lawes .	1	6·2	85·1	8·70	Lawes .	1	–	–	–	4·10	4·96	– –	–
		Brewers' Grains.	–	–	Johnston	1	75·8	23·0	1·19	– –	–	–	–	–	–	–	Johnston	1
		Distillers' Refuse.	1st	4235	Johnston	1	93·9	5·5	0·57	– –	–	–	–	–	–	–	Johnston	1
			2nd	10884	Johnston	1	84·5	14·6	0·90	– –	–	–	–	–	–	–	Johnston	1
	Maize –	Grain –	–	–	Payen .	1	10·0	88·9	1·08	Johnston	1	–	–	–	1·87	2·26	Payen .	1
	Dhoora –	Grain –	–	–	Johnston	1	12·0	86·0	2·0?	– –	–	–	–	–	–	–	Johnston	1
	Wheat –	Bran –	–	–	Playfair .	1	14·0	81·0	5·0	– –	–	–	–	–	–	–	– –	–
	Oat – –	Meal	–	–	Norton .	2	9·0	88·9	2·09	Norton .	9	–	–	–	2·67	3·23	Norton .	2
			–	–	Fromberg	2	9·0	89·2	1·80	– –	–	–	–	–	–	–	Fromberg	2
	Rye – –	Meal –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Barley –	Meal –	–	–	Playfair .	1	15·5	82·5	2·00	– –	–	–	–	–	–	–	Einhof .	1
	Maize –	Meal –	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Bulbs, Tubers, Fruit.	Turnip –	Meal –	–	–	Johnston	1	22·8	72·9	4·27	– –	–	–	–	–	–	–	Johnston	1
	Plantain –	Meal –	–	–	Johnston	3	14·1	83·6	2·32	– –	–	–	–	–	–	–	Johnston	3
	Carob Bean	Fruit –	0·9	–	Johnston	1	22·4	76·6	1·0?	– –	–	–	–	–	–	–	Johnston	1
	Water Yam	Tuber –	–	–	Johnston	1	64·8	34·2	1·0?	– –	–	–	–	–	–	–	Johnston	1
	Guinea Yam	Tuber –	–	–	Johnston	1	75·5	23·5	1·0?	– –	–	–	–	–	–	–	Johnston	1
	Sweet Potato	Tuber –	–	–	Johnston	1	59·3	39·7	1·0?	– –	–	–	–	–	–	–	Johnston	1

a. See Remarks on proximate analyses of linseed.——*b.* This is often used as a manure.——*c.* The Carob bean eatable part.——*d.* Professor Johnston has not given the amount of

I 2.—ARTICLES USED IN FEEDING.

PER CENT. Combustible Matter. Elements. Azotised. Albumen.	Gluten.	Casein.	Unazotised. Fat, Oil.	Starch.	Gum, Dextrine Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Inorganic Matter or Ash. Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
22·2			11·9	–	39·1	–	19·5	Fromberg	1	–	1·2	–	–	–	–	–	–	–	–	–	–	–	–	–a
–	–	–	11·9	–	–	–	–	Nesbit .	2	–	–	–	–	–	–	–	–	–	–	–	1·70	–	–	
–	–	–	13·5	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
22·2			12·4	–	36·3	–	12·7	Fromberg	1	–	0·3	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	11·4	–	–	–	–	Way . .	2	–	0·69	1·52	0·04	0·53	0·97	–	0·18	–	–	0·09	1·94	0·24	0·24	
–	–	–	–	–	–	–	–	Nesbit .	1	–	–	–	–	–	–	–	–	–	–	–	1·80	–	–	
–	–	–	9·1	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	9·8	–	–	–	–	Way . .	2	–	2·56	1·87	0·07	0·63	1·19	–	0·14	–	–	0·06	2·90	0·14	0·02	
25·5			12·4	–	35·1	–	10·2	Fromberg	1	–	1·7	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	11·6	–	–	–	–	Nesbit .	1	–	–	–	–	–	–	–	–	–	–	–	1·90	–	–	
–	–	–	11·1	–	–	–	–	Way . .	1	–	1·05	1·75	–	0·69	1·18	–	0·36	–	0·02	0·04	2·61	0·13	0·17	
0·9			–	63·2	12·8	14·6	?	Thomson	1	–	0·40	0·16	0·08	0·05	0·14	–	0·02	–	trace.		0·54	–	–	
0·9			–	61·9	14·6	13·6	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–b
0·6			–	–	1·1	–	21·3	Johnston	1	–	0·49	–	–	–	–	–	–	–	–	–	–	–	–	
?			–	?	?	?	–	Johnston	1	–	0·02	0·26		0·07		–	–	–	with Potash and Soda.		0·22	with Pot. and Soda.	–	
?			–	?	?	?	–	Johnston	1	–	0·19	0·35		0·06		–	–	–	with Potash and Soda.		0·30	with Pot. and Soda.	–	
11·1			8·1	64·1	0·4		5·2	Sprengel.	1	–	0·36	0·17	0·21	0·03	0·11	0·01	trace	–	Chl. 0·007		0·19	0·02	–	
6·3		4·6	–	67·4	1·2	1·8	4·7	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
1·1	1·8	14·6	5·9	59·5	2·0	2·4	1·6	Norton .	1	–	0·04	0·66		0·11	0·18	–	0·02	–	–	0·008	1·03	–	–	
1·3	1·2	15·4	6·1	59·0	2·1	1·7	2·4	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
1·0	3·7	?	?	67·8	4·7	5·3	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
13·7			1·1	–	4·1	45·9	8·1	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
4·4			0·4	67·4	4·5	2·0	4·9	Völcker .	1	–	0·04	0·86	0·05	0·009	0·17	–	0·009	–	–	0·58	0·18	0·06	0·36	
3·3			0·3	with fibre.	4·4	46·3	22·3	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–c
0·2	–	2·6	?	23·5	0·3	3·9	3·7	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
0·7	–	1·6	–	16·3	0·2	3·2	1·5	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
trace	–	2·6	–	16·2	0·6	7·8	12·5	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–d

encloses a hard stone, which amounts to about one-tenth of the whole fruit; the analysis is only calculated for the ash in these substances; I have supposed it to be 1 per cent.

I 2.—ARTICLES USED IN FEEDING.

I 2.—ARTICLES USED IN FEEDING.

			General Division.							ENTIRE COMPOSITION PER CENT.								
			In Natural State.							Organic or Combustible Matter.								
										Ultimate Elements.							Proximate Elements. Azotised.	
Class	Species	Part	Proportion per Cent.	Grains in Gallon.	Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Authority.	Number of Analyses.
Oilcake	Linseed	English	—	—	Fromberg	1	10·1	82·7	7·25	Way	11	—	—	—	4·60	5·57	Fromberg	1
					Nesbit	[illegible]	12·7	[illegible]	[illegible]	Nesbit	[illegible]	—	—	—	[illegible]	[illegible]	Way	11
			—	—	Way	[illegible]	[illegible]	[illegible]	[illegible]	Way	[illegible]	—	—	—	[illegible]	[illegible]	Way	9
		American	—	—	Fromberg	1	10·1	83·6	6·35	— —	—	—	—	—	—	—	Fromberg	1
			—	—	Lawes	1	11·1	83·2	[illegible]	Lawes	1	—	—	—	5·12	6·2[illegible]	— —	—
				—	Way	7	7·[illegible]	[illegible]	[illegible]	Way	7	—	—	—	4·74	[illegible]	Way	—
		Dutch, &c.	French		Nesbit	[illegible]	[illegible]	[illegible]	[illegible]	Nesbit	1	—	—	—	[illegible]	[illegible]	— —	—
			French		Way	8	7·6	81·0	11·40	Way	8	—	—	—	4·70	5·71	Way	8
			Dutch, &c.		Way	3	8·[illegible]	[illegible]	[illegible]	Way	3	—	—	—	4·6[illegible]	5·63	Way	3
	Gold of Pleasure.	Dutch	—	—	Fromberg	1	9·9	83·2	6·89	— —	—	—	—	—	—	—	Fromberg	1
	Rape	Dutch	—	—	Nesbit	1	8·7	79·0	12·28	Nesbit	1	—	—	—	5·15	6·23	Way	1
			—	—	Way	2	6·8	[illegible]	[illegible]	Way	1	—	—	—	5·23	6·33	Way	2
Corn.	Barley	Malt	81·0	—	Thomson	2	7·0	91·6	1·41	Thomson	3	41·2	6·5	42·4	1·37	1·66	Thomson	1
			77·4	—	Lawes	2	6·5	91·0	2·46	Lawes	3	—	—	—	1·57	1·90	Proust	1
		Malt Dust	8·5	—	Lawes	1	6·2	85·1	8·70	Lawes	1	—	—	—	4·10	4·96	— —	—
		Brewers' Grains.	—	—	Johnston	1	75·8	23·0	1·19	— —	—	—	—	—	—	—	Johnston	1
		Distillers' Refuse.	1st	4235	Johnston	1	93·9	5·5	0·57	— —	—	—	—	—	—	—	Johnston	1
			2nd	10884	Johnston	1	84·5	14·6	0·90	— —	—	—	—	—	—	—	Johnston	1
	Maize	Grain	—	—	Payen	1	10·0	88·9	1·08	Johnston	1	—	—	—	1·57	2·26	Payen	1
	Dhoora	Grain	—	—	Johnston	[illegible]	[illegible]	[illegible]	[illegible]	— —	—	—	—	—	—	—	Johnston	1
	Wheat	Bran	—	—	Playfair	1	14·0	81·0	5·0	— —	—	—	—	—	—	—	— —	—
	Oat	Meal	—	—	Norton	2	9·0	88·9	2·09	Norton	9	—	—	—	2·67	3·23	Norton	2
			—	—	Fromberg	2	9·0	89·2	1·80	— —	—	—	—	—	—	—	Fromberg	2
	Rye	Meal	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	— —	—
	Barley	Meal	—	—	Playfair	1	15·5	82·5	2·00	— —	—	—	—	—	—	—	Einhof	1
	Maize	Meal	—	—	— —	—	—	—	—	— —	—	—	—	—	—	—	— —	—
Bulbs, Tubers, Fruit.	Turnip	Meal	—	—	Johnston	1	22·8	72·9	4·27	— —	—	—	—	—	—	—	Johnston	1
	Plantain	Meal	—	—	Johnston	1	[illegible]	[illegible]	[illegible]	— —	—	—	—	—	—	—	Johnston	1
	Carob Bean	Fruit	0·9	—	Johnston	1	22·4	76·6	1·0?	— —	—	—	—	—	—	—	Johnston	1
	Water Yam	Tuber	—	—	Johnston	1	64·8	34·2	1·0?	— —	—	—	—	—	—	—	Johnston	1
	Guinea Yam	Tuber	—	—	Johnston	1	75·5	23·5	1·0?	— —	—	—	—	—	—	—	Johnston	1
	Sweet Potato	Tuber		—	Johnston	1	[illegible]	[illegible]	[illegible]	— —	—	—	—	—	—	—	Johnston	1

Proximate Elements. Azotised.			Unazotised.							Inorganic Matter or Ash.															
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Silica, Sand.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.		
[illegible]·2			[illegible]		[illegible]	—	[illegible]	Fromberg	1	—	1·2	—	—	—	—	—	—	—	—	—	—	—	—	a
—	—	—	[illegible]	—	—	—	—	Nesbit	[illegible]	—	—	—	—	—	—	—	—	—	—	—	1·7	—	—	
—	—	—	13·6	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
[illegible]			[illegible]	—	36·[illegible]	—	[illegible]·7	Fromberg	1	—	0·3	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	11·4	—	—	—	—	Way	8		0·[illegible]	1·[illegible]	[illegible]	0·[illegible]	[illegible]	—	0·15	—	—	0·0[illegible]	1·21	[illegible]	0·2[illegible]	
—	—	—	—	—	—	—	—	Nesbit	1	—	—	—	—	—	—	—	—	—	—	—	[illegible]	—	—	
—	—	—	9·1	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	9·8	—	—	—	—	Way	2	—	2·56	1·67	0·07	0·53	1·19	—	0·14	—	—	0·66	[illegible]	[illegible]	[illegible]	
23·5			12·4	—	35·1	—	10·2	Fromberg	1	—	1·7	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	11·6	—	—	—	—	Nesbit	1	—	—	—	—	—	—	—	—	—	—	—	1·9[illegible]	—	—	
—	—	—	11·1	—	—	—	—	Way	1	—	1·6[illegible]	1·7[illegible]	—	0·[illegible]	[illegible]·18	—	[illegible]·35	—	[illegible]	[illegible]	[illegible]	[illegible]	0·[illegible]	
0·9			—	63·2	12·8	14·6	?	Thomson	1	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	trace		[illegible]	—	—	
0·9			—	61·9	14·6	13·6	?	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	b
0·6			—	—	1·1	—	21·3	Johnston	1	—	0·49	—	—	—	—	—	—	—	—	—	—	—	—	
?			—	?	?	?	—	Johnston	1	—	0·02	0·26		0·07		—	—	—	with Potash and Soda.		0·22	with Potash and Soda.	—	
?			—	?	?	?	—	Johnston	1	—	0·19	0·35		0·06		—	—	—	with Potash and Soda.		0·30	with Potash and Soda.	—	
11·1			[illegible]·1	64·1	[illegible]		[illegible]	Sprengel	1	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	trace	—	[illegible] 0·07		0·1[illegible]	0·02	—	
6·3		4·6	—	67·4	1·2	1·6	4·7	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
[illegible]	[illegible]	[illegible]	5·[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Norton	1	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	—	—	[illegible]	[illegible]	—	—	
1·3	1·2	15·4	6·1	59·0	2·1	1·[illegible]	2·4	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
[illegible]			—	[illegible]	[illegible]	[illegible]	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
1·[illegible]			[illegible]·1		[illegible]	[illegible]	[illegible]	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
[illegible]·4			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	—	[illegible]	0·8[illegible]	0·06	0·09	0·1[illegible]	—	0·09	—		0·[illegible]	[illegible]	0·60	0·[illegible]	
3·3			0·3	with fibre	4·4	46·3	22·3	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	c
0·[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
0·7		1·[illegible]	—	[illegible]	—	[illegible]	[illegible]	— —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
[illegible]	—	[illegible]	—	16·[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	d

a. See Remarks on proximate analyses of linseed.—*b.* This is often used as a manure.—*c.* The Carob bean encloses a hard stone, which amounts to about one-tenth of the whole fruit; the analysis is only calculated for the eatable part.—*d.* Professor Johnston has not given the amount of ash in these substances; I have supposed it to be 1 per cent.

I 3.—ARTICLES USED IN FEEDING.

Class.	Species.	Parts.		General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic or Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Proximate. Ammonia.	Azotised. Authority.	Number of Anal.
Oilcakes.	Linseed	English	– –	Fromberg	1	226	1852	162	Way . .	11	–	–	–	103	125	Fromberg	1
			– –	Nesbit .	2	284	1835	121	Nesbit .	2	–	–	–	114	138	Way . .	11
			– –	Way . .	9	193	1884	163	Way . .	9	–	–	–	102	123	Way . .	9
		American.	– –	Fromberg	1	226	1872	142	– –	–	–	–	–	–	–	Fromberg	1
			– –	Lawes .	3	249	1864	127	Lawes .	3	–	–	–	115	139	– –	–
			– –	Way . .	7	170	1929	141	Way . .	7	–	–	–	106	128	Way . .	7
		Dutch, &c.	French	Nesbit .	1	278	1833	129	Nesbit .	1	–	–	–	118	143	– –	–
			French	Way . .	8	170	1815	255	Way . .	8	–	–	–	106	128	Way . .	8
			Dutch, &c.	Way . .	3	179	1846	215	Way . .	3	–	–	–	104	126	Way . .	3
	Gold of Pleasure.	Dutch .	– –	Fromberg	1	222	1864	154	– –	–	–	–	–	–	–	Fromberg	1
	Rape . .	Dutch	– –	Nesbit .	1	195	1770	275	Nesbit .	1	–	–	–	116	140	Way . .	1
			– –	Way . .	2	152	1909	179	Way . .	1	–	–	–	117	142	Way . .	2
Corn.	Barley .	Malt	1814 –	Thomson	2	157	2052	31	Thomson	2	924	146	951	31	38	Thomson	1
			1734 –	Lawes .	2	146	2038	56	Lawes .	2	–	–	–	35	42	Proust .	1
		Malt-dust.	78 –	Lawes .	1	139	1906	195	Lawes .	1	–	–	–	92	111	– –	–
		Brewers' Grains.	– –	Johnston	1	1698	515	27	– –	–	–	–	–	–	–	Johnston	1
		Distillers' Refuse.	– 1st	Johnston	1	2104	123	13	– –	–	–	–	–	–	–	Johnston	1
			– 2d	Johnston	1	1893	327	20	– –	–	–	–	–	–	–	Johnston	1
	Maize . .	Grain .	– –	Payen .	1	224	1992	24	Johnston	1	–	–	–	42	51	Payen .	1
	Dhoora . .	Grain .	– –	Johnston	1	269	1926	45 ?	– –	–	–	–	–	–	–	Johnston	1
	Wheat . .	Bran .	– –	Playfair .	1	314	1814	112	– –	–	–	–	–	–	–	– –	–
	Oat . . .	Meal	– –	Norton .	2	202	1991	47	Norton .	9	–	–	–	60	73	Norton .	2
			– –	Fromberg	2	202	1998	40	– –	–	–	–	–	–	–	Fromberg	2
	Rye . . .	Meal .	– –	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Barley . .	Meal .	– –	Playfair .	1	347	1848	45	– –	–	–	–	–	–	–	Einhof .	1
	Maize . .	Meal .	– –	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Bulbs, Tubers, Fruit.	Turnip . .	Meal .	– –	Johnston	1	511	1633	96	– –	–	–	–	–	–	–	Johnston	1
	Plantain .	Meal .	– –	Johnston	3	315	1873	52	– –	–	–	–	–	–	–	Johnston	3
	Carob Bean	Fruit .	stone included	Johnston	1	452	1544	20 ?	– –	–	–	–	–	–	–	Johnston	1
	Water Yam	Tuber .	– –	Johnston	1	1452	766	22 ?	– –	–	–	–	–	–	–	Johnston	1
	Guinea Yam	Tuber .	– –	Johnston	1	1691	527	22 ?	– –	–	–	–	–	–	–	Johnston	1
	Sweet Potato	Tuber .	– –	Johnston	1	1329	889	22 ?	– –	–	–	–	–	–	–	Johnston	1

a. The quantities in the proximate analyses are evidently too high, as Drs. Thomson and Proust have not included the tank into which the liquid runs.——*c.* Commonly called Indian-corn.——*d.* The fibre and husk being omitted causes one ton of the whole bean (including the stone).

I 3.—ARTICLES USED IN FEEDING.

PER TON, IN POUNDS.

Combustible Matter. Elements. Azotised.			Unazotised.						Inorganic Matter or Ash.															
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
	497		266	–	876	–	213	Fromberg	1	–	27	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	266	–	–	–	–	Nesbit .	2	–	–	–	–	–	–	–	–	–	–	–	38	–	–	
–	–	–	302	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	497		278	–	813	–	284	Fromberg	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	255	–	–	–	–	Way . .	2	–	15	34	1	12	22	–	4	–	–	2	43	5	5	
–	–	–	–	–	–	–	–	Nesbit .	1	–	–	–	–	–	–	–	–	–	–	–	40	–	–	
–	–	–	204	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	220	–	–	–	–	Way . .	2	–	57	42	2	14	27	–	3	–	–	1	65	3	0·5	
	571		278	–	786	–	229	Fromberg	1	–	38	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	260	–	–	–	–	Nesbit .	1	–	–	–	–	–	–	–	–	–	–	–	43	–	–	
–	–	–	249	–	–	–	–	Way . .	1	–	24	39	–	15	26	–	8	–	0·5	1	59	3	4	
	20		–	1416	287	327	?	Thomson	1	–	9	4	2	1	3	–	0·5	–	trace		12	–	–	–a
	20		–	1386	327	305	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	13		–	–	25	–	477	Johnston	1	–	11	–	–	–	–	–	–	–	–	–	–	–	–	
	?		–	?	?	?	–	Johnston	1	–	0·5	6		2		–	–	–	with potash and soda.		5	with potash & soda.	–	–b
	?		–	?	?	?	–	Johnston	1	–	4	8			1	–	–	–	with potash and soda.		7	with potash & soda.	–	
	249		181	1436	9		117	Sprengel	1	–	8	4	5	1	2	0·2	trace	–	Chl. 0·2		4	0·3	–	–c
	244		–	1510	27	40	105	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
24	40	327	132	1333	45	54	36	Norton .	1	–	1	15		3	4	–	0·5	–	–	0·2	23	–	–	
29	25	349	136	1320	47	38	53	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
22	83	–	?	1519	105	119	?	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–d
	307		25	–	92	1028	181	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	99		9	1510	100	45	110	Völcker .	–	–	1	19	1	0·2	4	–	0·2	–	–	13	4	1	8	
	67	–	6	with fibre	89	933	449	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–e
5	–	58	?	526	7	87	83	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
16	–	36	–	365	4	72	34	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
?	–	58	–	363	13	175	280	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

husk or fibre.——*b*. No. 1 is the clearer liquid of the distilled worts; and No. 2 is the thicker matter that subsides in the
the remaining constituents to be relatively too high.——*e*. This analysis gives the total weight of the eatable portion in

K 1.—WEEDS.

Class.	Species.	Common Name.			General Division. Dried at 212° Fahr.					COMPOSITION OF Organic or								
										Ultimate Elements.							Proximate Azotised.	
					Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Authority.	Number of Anal.
Annual or Biennial Weeds.	Anthemis arvensis	Chamomile	–	–	Liebig .	1	–	90·3	9·66	– –	–	–	–	–	–	–	– –	–
	Matricaria chamomilla	Wild ditto	–	–	Liebig .	2	–	90·9	9·10	– –	–	–	–	–	–	–	– –	–
	Sinapis, &c.	Charlock	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Stellaria media	Chickweed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Agrostemma githago	Corn cockle	–	–	Liebig .	1	–	86·8	13·20	– –	–	–	–	–	–	–	– –	–
	Centaurea cyanus	Corn blue-bottle	–	–	Liebig .	1	–	92·7	7·32	– –	–	–	–	–	–	–	– –	–
	Chrysanthemum segetum	Corn marigold	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Papaver rheas	Corn poppy	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Spergula arvensis	Corn spurrey	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Heracleum spondyleum	Cow parsnip	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Arctium Lappa	Burdock	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Bromus mollis	Brome grass	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Digitalis purpurea	Foxglove	–	–	Liebig .	1	–	89·1	10·89	– –	–	–	–	–	–	–	– –	–
	Bromus secalinus	Goose grass	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Senecio vulgaris	Groundsel	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Conium maculata	Hemlock	–	–	Liebig .	1	–	87·2	12·80	– –	–	–	–	–	–	–	– –	–
	– –	Knapweed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Polygonum aviculare	Knot grass	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Sonchus oleraceus	Sow thistle	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Cnicus lanceolatus	Spearthistle	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
Perennial Weeds.	Convolvulus arvensis	Bindweed	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Centaurea nigra	Black knapweed.	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Ranunculus bulbosus	Buttercup	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Tussilago farfara	Coltsfoot	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Cnicus arvensis	Corn thistle	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Sonchus arvensis	Corn sow thistle	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Triticum repens	Couch grass	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Bellis perennis	Daisy . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Taraxicum officinale	Dandelion	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Rumex obtusifolius	Dock . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Urtica dioica	Nettle . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Chrysanthemum leucanthemum	Oxeye . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Arrhenatherum avenaceum	Oat grass .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Spartium serparium	Broom .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Acorus calamus	Sweet rush	–	–	Liebig .	1	–	93·1	6·90	– –	–	–	–	–	–	–	– –	–
	Arundo phragmitis	Common reed	–	–	Johnston	1	–	98·5	1·44	– –	–	–	–	–	–	–	– –	–
	Filices. . .	Ferns . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Erica . . .	Heath . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Carex . . .	Sedges . .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Scabiosa arvensis	Field scabious	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Chelidonium majus	Celandine	–	–	Liebig .	1	–	93·1	6·85	– –	–	–	–	–	–	–	– –	–
	All weeds from inferior Turnip soil.		–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–

a. The Analyses are intended rather to give a general idea of the composition of Weeds than to be of any immediate practical growing crop, as far as similarity of composition would show it, as also those that are most valuable for manure, from a importance, as they are generally applied in the form of ashes.——*c.* This analysis was quoted from 'The Farmers' and

K 1.—WEEDS.

EACH PORTION PER CENT.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	Liebig .	1	–	6·8	30·6	–	16·0	3·7	–	3·3	–	7·2	–	11·4	4·6	?	–*a*
–	–	–	–	–	–	–	–	Liebig .	2	–	1·6	28·9	–	17·8	4·9	–	1·7	–	16·4	–	7·2	4·6	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Liebig .	1	–	2·4	22·9	–	29·3	6·1	–	1·2	–	7·6	–	7·2	2·4	?	
–	–	–	–	–	–	–	–	Liebig .	1	–	3·3	36·5	–	15·5	4·6	–	1·6	–	11·9	–	7·3	2·7	?	
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–	–	–	–	–	–	–	–	Liebig .	1	–	12·8	43·5	3·7	15·7	6·5	–	3·2	–	–	9·0	1·7	3·9	?	–*b*
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–	–	–	–	–	–	–	–	Liebig .	1	–	2·6	21·7	9·6	25·0	8·4	–	2·4	–	–	16·6	10·3	3·4	?	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
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–	–	–	–	–	–	–	–	Liebig .	1	–	2·4	32·9	–	11·5	7·7	–	1·9	–	14·7	2·8	13·2	5·1	?	
–	–	–	–	–	–	–	–	Johnston	1	–	78·9	4·8		6·1	0·3	–	0·9	–	Chl. 0·2		3·2	5·5	?	
–	–	–	–	–	–	–	–	Berthier .	1	–	16·5	13·2	–	28·7	0·2	–	0·7	0·2	9·0	–	5·6	1·5	24·4	
–	–	–	–	–	–	–	–	Berthier .	1	–	37·5	7·4	–	21·4	1·0	–	1·4	6·1	1·2	–	7·3	2·3	14·4	
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	Hodges .	1	–	13·3	46·7	1·0	29·4	7·1	–	0·9	–	Chl. 3·5		1·2	1·9	?	
–	–	–	–	–	–	–	–	Liebig .	1	–	1·4	33·1	–	23·4	5·1	–	1·2	–	3·4	–	15·7	2·3	?	
–	–	–	–	–	–	–	–	?	–	–	51·1	8·6	4·2	15·1	5·1	trace	1·3		Chl. 2·1		10·9	1·5	0·08	–*c*

use. There is a large field here open to the researches of Chemists to determine what weeds are most injurious to the like reason.——*b.* I have not been able to give the entire composition of these weeds, but it is a point of no great practical Gardeners' Chronicle,' without giving the authority.

L 1.—TREES.

Class.	Species.	Parts.	Specific Gravity.		General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	COMPOSITION OF EACH … Organic or … Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Proximate … Azotised. Authority.	Number of Anal.
Fruit Trees.	Apple .	Wood .	0·79	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Pear .	Wood .	0·66	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	– –	–	–	–	–	Boussingault and Payen.	1	–	–	–	1·59	1·92	– –	–
	Cherry	Wood .	0·75	–	Liebig . .	1	–	99·7	0·28	– –	–	–	–	–	–	–	– –	–
		Bark .	–	–	Liebig . .	1	–	89·6	10·37	– –	–	–	–	–	–	–	– –	–
	Plum .	Wood .	0·78	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Filbert	Wood .	0·60	–	De Saussure	1	–	99·5	0·5	– –	–	–	–	–	–	–	– –	–
		Bark .	–	–	De Saussure	1	–	93·8	6·2	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	De Saussure	1	–	93·0	7·0	– –	–	–	–	–	–	–	– –	–
	Walnut .	Wood .	0·67	–	Berthier .	1	–	98·4	1·57	– –	–	–	–	–	–	–	– –	–
Forest Trees.	Oak .	Wood .	1·17	old	Berthier .	1	–	97·5	2·50	Payen . .	1	39·4	6·2	54·4	–	–	– –	–
		Bark .	–	–	Berthier .	1	–	94·0	6·0	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	De Saussure	1	–	94·5	5·5	Boussingault and Payen.	1	–	–	–	1·57	1·90	– –	–
	Ash . .	Wood .	0·84	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Elm .	Wood .	0·67	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Bark .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Fir .	Wood .	0·52	–	Liebig . .	1	–	99·86	0·14	– –	–	–	–	–	–	–	– –	–
		Bark .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	De Saussure	1	–	97·1	2·9	– –	–	–	–	–	–	–	– –	–
	Larch .	Wood .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Beech	Wood .	0·85	–	De Saussure	1	–	99·4	0·6	Payen . .	1	39·3	6·3	54·4	–	–	– –	–
		Bark .	–	–	De Saussure	1	–	86·6	13·4	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	– –	–	–	–	–	Boussingault and Payen.	1	–	–	–	1·91	2·31	– –	–
	Birch .	Wood .	–	–	Berthier .	1	–	99·0	1·0	– –	–	–	–	–	–	–	– –	–
	Chesnut	Wood .	–	–	De Saussure	1	–	96·5	3·5	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	De Saussure	1	–	91·4	8·6	– –	–	–	–	–	–	–	– –	–
	Lime .	Wood .	0·60	–	Berthier .	1	–	95·0	5·0	– –	–	–	–	–	–	–	– –	–
		Bark .	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	– –	–
	Poplar	Wood .	0·38	–	De Saussure	1	–	99·2	0·8	– –	–	–	–	–	–	–	– –	–
		Bark .	–	–	De Saussure	1	–	92·8	7·2	– –	–	–	–	–	–	–	– –	–
		Leaves	–	–	De Saussure	1	–	90·7	9·3	Boussingault and Payen.	1	–	–	–	1·17	1·42	– –	–

a. For all practical purposes the analyses by Liebig in this Table must be reduced by the amount of Carbonic Acid (say ought not to contain any Carbonic Acid, but as the Ash left after the combustion of any substance, where organic Acids other ingredients present in the Ash. The quantity of Ash contained in trees, according to Liebig, depends upon the the various woods is from a table in the 'Rural Encyclopædia,' where it states that it varies considerably with the age Salts, or earthy Carbonates. I have taken the mean of the two Alkalies as the base, and the earthy Carbonates are the amount of the Salts only.——*d.* I have not attempted to give the entire composition of a tree, because, in the first varying, as they do, with the growth and age of the tree. I may here mention that all the analyses of leaves in this

L 1.—TREES.

PORTION PER CENT.

Combustible Matter. Elements. Azotised.			Unazotised.					Inorganic Matter or Ash.															
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	–	–	–	–	–	–	–	Liebig . .	1	–	1·3	19·2	0·5	63·6	7·5	–	1·7	–	–	0·5	4·9	0·9	? –a
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·1	20·8	8·4	28·7	9·2	–	0·07	–	–	trace	7·7	3·3	?
–	–	–	–	–	–	–	–	Liebig . .	1	–	20·0	7·5	14·5	42·0	5·1	–	0·2	–	–	0·6	3·3	0·8	?
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	Berthier .	1	–	3·7	11·3		35·9	3·7	–	3·4	–	Chl. 0·08		4·1	0·8	34·4 –b
–	–	–	–	–	–	–	–	Liebig . .	1	–	0·5	5·7	3·8	50·6	3·0	–	0·4	–	–	0·02	2·3	0·8	?
–	–	–	–	–	–	–	–	Berthier .	1	–	1·1	3·5		47·5	0·8	–	–	7·2	Chl. 0·03		–	0·3	37·8
–	–	–	–	–	–	–	–	De Saussure	1	–	14·5	27·4		16·7	3·6	–	1·8	–	–	?	10·9	?	25·1 –c
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	3·1	21·9	13·7	47·8	7·7	–	1·2	–	–	–	3·3	1·3	?
–	–	–	–	–	–	–	–	Liebig . .	1	–	8·8	2·2	10·1	72·7	3·2	–	0·8	–	–	–	1·6	0·6	?
–	–	–	–	–	–	–	–	Liebig . .	1	–	3·0	2·8	16·0	31·7	19·8	–	3·5	18·2	–	1·5	1·6	1·9	?
–	–	–	–	–	–	–	–	Hertwig .	1	–	17·3	1·9		38·6	2·4	0·6	0·6	–	–	–	7·1	?	29·7
–	–	–	–	–	–	–	–	Hertwig .	1	–	11·6	10·5		36·8	3·1	0·2	0·5	–	–	–	4·7	0·9	31·7
–	–	–	–	–	–	–	–	Liebig . .	1	–	3·6	15·2	7·3	27·0	24·5	–	4·3	13·2	–	0·9	1·9	1·8	?
–	–	–	–	–	–	–	–	Liebig . .	1	–	1·1	11·8	2·0	47·3	8·4	–	0·6	–	–	0·2	2·3	1·0	? –d
–	–	–	–	–	–	–	–	Hertwig .	1	–	9·2	2·0		37·5	17·1	0·3	0·3	–	–	–	2·7	?	29·6
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Berthier .	1	–	4·8	12·7		43·8	2·5	–	0·4	2·9	Chl. 0·03		5·6	0·4	28·7
–	–	–	–	–	–	–	–	Berthier .	1	–	7·5	10·1		43·6	3·2	–	3·0	–	Chl. 0·07		1·5	1·2	28·8
–	–	–	–	–	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Liebig . .	1	–	5·3	35·8	5·2	29·9	4·2	–	8·0	–	–	1·5	4·9	5·3	?
–	–	–	–	–	–	–	–	Liebig . .	1	–	2·3	16·1	4·5	60·8	8·0	–	1·2	–	–	2·2	4·0	0·8	?
–	–	–	–	–	–	–	–	De Saussure	1	–	3·3	32·6		18·3	3·3	–	1·5	–	–	?	10·1	?	29·9
–	–	–	–	–	–	–	–	De Saussure	1	–	4·0	18·8		35·1	1·0	–	1·5	–	–	?	3·2	?	36·4
–	–	–	–	–	–	–	–	De Saussure	1	–	11·5	28·5		21·4	1·4	–	1·5	–	–	?	4·2	?	31·5

one-third), as they have all been calculated without it. It is certainly true that, theoretically speaking, the Inorganic Matter are present, always contains it, it becomes necessary to calculate its amount in order to obtain the actual quantities of the age of the part; the leaves and twigs, for instance, containing much more than the stem.——*b*. The specific gravity of of the tree.——*c*. The analyses by De Saussure are only an approximation to the truth, as he has not separated the Alkaline calculated as Carbonate of Lime; as, however incorrect this method is, I thought it less likely to lead to error than giving place, it was not practically required; and secondly, it would be almost impossible to give a fair average of the constituents, table were made on those that fell in autumn.

M 1.—MINERALS.

Class.	Species.				General Division.					ENTIRE COMPOSITION										
					In Natural State.					Organic Matter.								Inorganic		
										Ultimate Elements.										
					Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.
	Albite	–	–	–	Liebig	1	–	–	100	– –	–	–	–	–	–	–	–	Liebig	1	–
		–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Anorth.	–	–	–	Liebig	1	–	–	100	– –	–	–	–	–	–	–	–	Liebig	1	–
	Apatite	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
		–	–	–	Parkes	1	–	–	100	– –	–	–	–	–	–	–	–	Parkes	1	–
	Augite	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Chlorite	–	–	–	Parkes	1	–	–	100	– –	–	–	–	–	–	–	–	Parkes	1	–
	Phonolite (clinkstone.)	–	–	–	Gmelin	1	0·6	–	99·4	– –	–	–	–	–	–	–	–	Gmelin	1	–
	Cyanite	–	–	–	Parkes	1	–	–	–	– –	–	–	–	–	–	–	–	Parkes	1	–
		–	–	–	Brande	1	–	–	–	– –	–	–	–	–	–	–	–	Brande	1	–
	Diallage	–	–	–	Köhler	1	1·8	–	98·2	– –	–	–	–	–	–	–	–	Köhler	1	–
		–	–	–	Köhler	1	0·2	–	99·8	– –	–	–	–	–	–	–	–	Köhler	1	–
	Diopside	–	–	–	Bousdorff	1	–	–	100	– –	–	–	–	–	–	–	–	Bousdorff	1	–
	Felspar	–	–	–	Liebig	1	–	–	100	– –	–	–	–	–	–	–	–	Liebig	1	–
		–	–	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	Herepath	1	–
	Hedenbergite	–	–	–	Rose	1	–	–	100	– –	–	–	–	–	–	–	–	Rose	1	–
	Hypersthene	–	–	–	Rose	1	–	–	100	– –	–	–	–	–	–	–	–	Rose ?	1	–
		–	–	–	Klaproth	1	1·0	–	99·0	– –	–	–	–	–	–	–	–	Klaproth	1	–
	Labrador	–	–	–	Liebig	1	–	–	100	– –	–	–	–	–	–	–	–	Liebig	1	–
	Leucite	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Mica	–	–	–	Nesbit	3	–	–	100	– –	–	–	–	–	–	–	–	Nesbit	3	–
		–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Pinite	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Prehnite	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Pyrites	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	53
	Serpentine	–	–	–	Parkes	1	10·5	–	89·5	– –	–	–	–	–	–	–	–	Parkes	1	–
		–	–	–	Sir H. de la Beche.	2	14·4	–	85·6	– –	–	–	–	–	–	–	–	Sir H. de la Beche.	2	–
	Sodalite	–	–	–	Brande	1	–	–	100	– –	–	–	–	–	–	–	–	Brande	1	–
	Talc	–	–	–	Parkes	1	6·0	–	94·0	– –	–	–	–	–	–	–	–	Parkes	1	–
	Zeolite	–	–	–	Liebig	1	6·7	–	93·3	– –	–	–	–	–	–	–	–	Liebig	1	–
	Quartz	–	–	–	Parkes	1	–	–	100	– –	–	–	–	–	–	–	–	Parkes	1	–
	Hornblende	–	–	–	Parkes	1	–	–	100	– –	–	–	–	–	–	–	–	Parkes	1	–
		–	–	–	Karkeek	1	–	–	100	– –	–	–	–	–	–	–	–	Karkeek	1	–

a. Very variabl

M 1.—MINERALS.

PER CENT.																										
Matter or Ash.																										
Soluble in Rain-Water.														Total Inorganic Matter.												
Abundantly.									Sparingly.																	
Potash.	Soda.	Chloride Potass.	Chloride Sodium.	Magnesia.	Iron.	Phosph. Acid.	Sulphur. Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid
–	–	–	–	–	–	–	–	–	–	–	–	–	–	69·8	–	11·4	–	–	18·8	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	70·6	–	11·7	–	–	17·6	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	44·5	–	–	15·7	5·2	34·5	0·7	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	54·0	–	–	–	–	–	–	46·0	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	55·0	–	–	–	–	–	–	45·0	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	57·1	–	–	25·0	17·9	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	?	–	–	?	?	?	?	–	–	–	–	–	– –*a*
–	–	–	–	–	–	–	–	–	–	–	–	–	–	62·0	8·3	6·2	0·3	–	17·7	3·8	1·1	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	43·0	–	–	–	–	55·5	0·5	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	30·8	–	–	–	–	69·2	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	53·2	–	–	19·1	14·9	2·5	8·7	0·3	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	56·8	–	–	2·2	29·7	2·1	8·5	0·6	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	54·8	–	–	24·8	18·6	0·3	1·0	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	65·9	16·3	–	–	–	17·8	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	64·1	16·3	–	0·5	–	19·0	trace	–	–	–	trace		–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	49·0	–	–	20·9	–	26·1	3·0	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	54·8	–	–	–	16·3	–	29·0	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	54·3	–	–	1·5	14·0	2·3	24·5	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	55·8	–	4·0	11·0	–	26·5	1·3	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	55·7	20·8	–	–	–	23·5	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	44·0	10·7	–	–	11·7	18·2	14·1	1·3	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	49·3	36·9	–	–	–	13·8	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	48·0	16·0	–	–	–	36·0	?	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	43·9	–	–	19·1	–	37·0	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	46·6	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	31·5	–	–	0·3	48·0	3·0	5·5	1·5	–	–	–	–	0·2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	42·2	–	–	0·1	38·7	0·7	1·8	0·3	–	–	–	–	1·7
–	–	–	–	–	–	–	–	–	–	–	–	–	–	35·5	–	17·7	–	–	30·0	–	–	–	16·7	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	62·0	–	–	–	27·0	1·5	3·5	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	38·8	1·4	13·8	10·5	–	28·8	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	99·0	–	–	–	–	1·0		–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	45·7	–	–	13·9	18·8	12·2	7·3	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	47·2	–	–	12·7	21·9	12·2	2·3	–	–	–	–	–	–

in composition.

N 1.—ROCKS.

Rocks.	Minerals.				General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic. Authority.	Number of Analyses.
Basalt	Zeolite, Iron-ore, Hornblende.	–	–	–	Klaproth	1	6·0	–	94·0	–	–	–	–	–	–	–	–	Klaproth	1
		–	–	–	Lowe . .	1	2·9	–	97·1	–	–	–	–	–	–	–	–	Lowe .	1
Chlorite Schist.	Quartz, Felspar, Chlorite, Hornblende. .	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Clay Slate	Quartz, Felspar, Hornblende, Chlorite .	–	–	–	Frick . .	1	3·3	–	96·7	–	–	–	–	–	–	–	–	Frick . .	1
Diallage	Felspar, Hornblende.	–	–	–	Whitley .	1	–	–	100	–	–	–	–	–	–	–	–	Whitley .	1
Felspar .	Felspar .	–	–	–	Liebig .	1	–	–	100	–	–	–	–	–	–	–	–	Liebig .	1
		–	–	–	Karkeek	1	–	–	100	–	–	–	–	–	–	–	–	Karkeek	1
Gneiss .	Quartz, Mica, Felspar, Hornblende.	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Granite	Quartz, Mica, Felspar, Hornblende	–	–	–	Sir H. de la Beche	2	–	–	100	–	–	–	–	–	–	–	–	Sir H. de la Beche.	2
Grauwacke	Quartz, Mica	–	–	–	Thomson	1	–	–	100	–	–	–	–	–	–	–	–	Thomson	1
Greenstone.	Quartz, Felspar, Hornblende	–	–	–	Thomson	1	1·7	–	98·3	–	–	–	–	–	–	–	–	Thomson	1
Gypsum .	– –	–	–	–	Parkes .	1	21·0	–	79·0	–	–	–	–	–	–	–	–	Parkes .	1
Hornblende Schist.	Hornblende, Felspar . .	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Limestone .	Common .	Lanarkshire			Johnston	4	–	–	100	–	–	–	–	–	–	–	–	Johnston	4
		Do. burnt			Johnston	4	–	–	100	–	–	–	–	–	–	–	–	Johnston	4
	Common .	Co. Down			Hodges .	1	1·4	–	98·6	–	–	–	–	–	–	–	–	Hodges .	1
	Magnesian	Durham			Johnston	13	–	–	100	–	–	–	–	–	–	–	–	Johnston	13
		Do. burnt			Johnston	13	–	–	100	–	–	–	–	–	–	–	–	Johnston	13
	Magnesian	Berwickshire			Johnston	4	–	–	100	–	–	–	–	–	–	–	–	Johnston	4
		Do. burnt			Johnston	4	–	–	100	–	–	–	–	–	–	–	–	Johnston	4
Mica Schist.	Mica, Quartz, Hornblende.	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Porphyry	Quartz, Mica, Felspar, Hornblende.	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Quartz .	Quartz, Mica, Felspar. .	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Sandstone.	Quartz, Mica, Felspar. .	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Serpentine. .	Talc, Hornblende. .	–	–	–	Karkeek	2	14·4	–	85·6	–	–	–	–	–	–	–	–	Karkeek	2
Shale	Mica . .	Craiglockhart			Anderson	1	?	6·5	93·5	–	–	–	–	–	–	–	–	Anderson	1
Syenite	Quartz, Mica, Felspar, Hornblende.	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–
Talcose Schist	Talc, Quartz	–	–	–	Parkes .	1	6·0	–	94·0	–	–	–	–	–	–	–	–	Parkes .	1
	– –	Banffshire		–	Johnston	1	?	–	100	–	–	–	–	–	–	–	–	Johnston	1
Whinstone.	– –	–	–	–	– –	–	–	–	–	–	–	–	–	–	–	–	–	– –	–

a. The minerals mentioned under that column are those that are found in the several rocks; although all of them are not
b. Soils on these rocks variable in fertility.—*c.* Variable fertility.—*d.* Very fertile.

N 1.—ROCKS.

PER CENT.

Matter or Ash.

Total Sulphur.	Soluble in Rain Water. Abundantly. Potash.	Soda.	Chloride Potassim.	Chloride Sodium.	Magnesia	Iron.	Phospho. Acid.	Sulphuric Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potass.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	44·5	–	2·6	9·5	–	17·0	20·0	?	–	–	–	–	–	–a
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	47·3	0·6	5·5	18·1	10·0	11·4	4·6	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	62·5	3·4	–	3·4	2·2	16·8	8·4	–	–	–	–	–	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56·0	12·0		4·0	6·0	17·0	5·0	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	65·9	16·3	–	–	–	17·8	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	65·2	16·7	–	–	–	18·1	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	73·4	8·0	–	0·2	0·9	15·7	1·8	0·1	–	–	–	–	–	–b
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	72·2	1·		1·0	2·3	11·7	10·4	–	trace		0·4	–	–	–c
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	50·7	trace	–	8·9	10·0	6·3	21·4	–	–	–	1·0	–	–	–d
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	33·0	–	–	–	–	–	–	–	46·0	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–e
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1·7	–	–	53·5	0·7	1·2		–	–	–	0·2	0·2	42·5	
–	–	–	–	–	–	–	–	–	–	–	?	?	?	–	2·8	–	–	90·0	1·2	2·0		–	–	–	0·3	0·3	3·3	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2·4	–	–	52·9	0·7	0·4		–	–	–	?	trace	42·2	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6·8	–	–	38·0	11·7	0·9		–	–	–	?	–	42·7	
–	–	–	–	–	–	–	–	–	–	–	?	?	–	–	11·8	–	–	66·3	20·4	1·5		–	–	–	?	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19·2	–	–	24·3	16·8	2·1		–	–	–	?	–	37·6	
–	–	–	–	–	–	–	–	–	–	–	?	?	–	–	29·5	–	–	37·4	25·9	3·2		–	–	–	?	–	4·0	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	42·2	–	–	0·1	38·7	0·7	1·8	0·3	–	–	–	–	1·7	–f
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	84·2	0·3	0·1	2·3	trace	1·7	4·2	–	–	–	0·04	0·4	0·6	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–g
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	62·0	–	–	–	27·0	1·5	3·5	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	52·7	7·3		1·5	4·1	20·2	13·8	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

always present in every specimen. The authority for their composition is Dr. M'Culloch's Treatise on Rocks.——
——*e*. Very fertile.——*f*. Soils on these rocks barren.——*h*. Soils on these rocks fertile.

O 1.—EARTHS.

Class.	Species.	Locality.		General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic. Authority.	Number of Analyses.
Alluvial.	River Mud (warp).	Kirkcudbright.	–	Johnston	2	?	2·9	97·1	– –	–	–	–	–	–	–	–	Johnston	2
		Trent .	–	Herepath	1	6	6·6	87·4	– –	–	–	–	–	–	–	–	Herepath	1
	Shell Sand	Normandy	–	Johnston	1	?	5·1	94·9	Boussingault and Payen.	1	–	–	–	0·13	0·16	–	Johnston	1
		Isla . .	–	Johnston	2	?	?	100	– –	–	–	–	–	–	–	–	Johnston	2
		Devonshire	(coral)	Herepath	1	0·5	2·4	97·1	Boussingault and Payen.	1	–	–	–	0·51	0·62	–	Herepath	1
	Clay . . .	Portobello	–	Cameron	1		8·6	91·4	– –	–	–	–	–	–	–	–	Cameron	1
Crag.	Red (?) Coralline.	Various .	–	Nesbit .	7	?	?	100	– –	–	–	–	–	–	–	–	Nesbit .	7
Clays.	Pipe Clay .	Devonshire	–	Johnston	1	11·2	–	88·8	– –	–	–	–	–	–	–	–	Johnston	1
	Porcelain .	Meissen .	–	Liebig .	2		100		– –	–	–	–	–	–	–	–	Liebig .	2
	Tile . .	Dunferline	–	Jones . .	1	2·8	5·0	92·2	– –	–	–	–	–	–	–	–	Jones .	1
		Ayrshire.	–	Fromberg	5		5·4	94·6	– –	–	–	–	–	–	–	–	Fromberg	5
	Fire . .	Different Localities	–	Johnston	4	8·4	–	91·6	– –	–	–	–	–	–	–	–	Johnston	4
Marls.	Peat .	Forfarshire	–	Johnston	3	?	11·2	88·8	– –	–	–	–	–	–	–	–	Johnston	3
		Forfarshire	–	Colvill .	1	?	35·0	65·0	– –	–	–	–	–	–	–	–	Colvill .	1
	Clay . .	Ayrshire	–	Johnston	1	1·4	2·8	95·8	– –	–	–	–	–	–	–	–	Johnston	1
		Cornwall	–	Hunt .	2	?	?	100	– –	–	–	–	–	–	–	–	Hunt . .	2
	Chalk . .	Farnham	–	Way . .	1	?	?	100	– –	–	–	–	–	–	–	–	Way . .	1
			–	Nesbit .	3	?	?	100	– –	–	–	–	–	–	–	–	Nesbit .	3
	Upper Green Sand	Farnham	–	Way . .	4	?	4·5	95·5	– –	–	–	–	–	–	–	–	Way . .	4
				Nesbit .	1		100		– –	–	–	–	–	–	–	–	Nesbit .	1
	Lower Green Sand	Farnham	–	Way . .	1	?	2·3	97·7	– –	–	–	–	–	–	–	–	Way . .	1
	Magnesian	Sutherlandshire	–	Johnston	1	?	?	100	– –	–	–	–	–	–	–	–	Johnston	1
	Powdery	Boyne .	(white)	Johnston	1	1·5	1·4	97·1	– –	–	–	–	–	–	–	–	Johnston	1
		Boyne .	(blue)	Johnston	1	2·0	1·1	96·9	– –	–	–	–	–	–	–	–	Johnston	1
Chalk.	Upper . .	Meudon .	–	Berthier .	1	?	–	100	– –	–	–	–	–	–	–	–	Berthier	1
				Nesbit .	2		100		– –	–	–	–	–	–	–	–	Nesbit .	2
	Lower . .	Maestricht	–	Römer .	1	1·5	–	98·5	– –	–	–	–	–	–	–	–	Römer .	1
				Nesbit .	7		100		– –	–	–	–	–	–	–	–	Nesbit .	7
Green Sand.	Upper Green Sand	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Fossils in do.	Farnham	–	Way . .	4	?	2·7	97·3	– –	–	–	–	–	–	–	–	Way . .	4
		Isle of Wight, &c.	–	Nesbit .	23		100		– –	–	–	–	–	–	–	–	Nesbit .	23
	Gault Fossil	Farnham	–	Way . .	1	8·9	2·9	88·2	– –	–	–	–	–	–	–	–	Way . .	1
	Lower Green Sand	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Fossils in do.	Farnham	–	Way . .	1		3·4	96·6	– –	–	–	–	–	–	–	–	Way . .	1

a. Warp dried in air.——*b.* Infusorial sand, composed of very minute shells.——*c.* Pure.——*d.* Best in Scotland.——*e.* Good manure in Cornwall.——*i.* The mean of the whole marl, including lumps, &c.——*k.* Naturally very dry.——*l.* Very nume- of fluorine, which is included in the water as not being of any known service to the farmer.——*n.* Rather scarce.

O 1.—EARTHS.

PER CENT.

Matter or Ash.

Total Sulphur.	Soluble in Rain-water. Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sod.	Magnesia	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia	Sulph. Acid.	Carbonic Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
-	Salts 0·5					–	–	–	–	?	4·1	0·6	0·2	3·7	82·9	Salts 0·5		4·1	0·6	1·9	3·6	–	with Salts		–	0·2	3·7	
-	–	–	–	–	–	–	–	–	–	?	4·8	0·6	trace	4·8	64·9	0·09		5·8	3·2	4·2	4·2	trace	–	–	0·04	trace	4·8	-a
-	–	0·3	Chl. 1·2		–	–	–	–	–	?	24·7	trace	0·2	19·1	47·7	–	0·3	24·7	trace	0·2 with Sil.	1·2	trace	Chl. 1·2		–	0·2	19·1	-b
-	–	–	–	–	–	–	–	–	–	?	17·5	–	–	13·6	68·7	–	?	17·5	–	?	?	–	–	?	0·2	–	13·6	
-	Salts 0·3				–	–	–	–	–	?	26·5	0·05	trace	20·9	48·8	trace	Salts 0·3	26·5	0·05	0·05		–	–	with Salts.	0·01	trace	20·9	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	54·0	1·5		0·7	1·6	25·5	8·1	–	–	–	–	–	–	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0·4	–	–	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	49·6	–	–	–	–	37·4	–	–	–	–	–	–	–	-c
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	49·8	2·4	–	–	–	34·2	–	–	–	–	–	–	–	
-	0·9	0·4	–	–	–	?	–	–	–	1·9	1·1	0·3	1·4	0·4	64·1	1·9	0·7	1·8	0·9	13·5	7·6	trace	–	–	–	1·4	0·4	-d
-	?	?	–	–	–	?	–	–	–	?	?	?	?	?	59·4	3·9		1·0	1·0	21·2	7·2	–	–	–	–	?	?	-e
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	52·6	–	–	1·3	0·2	36·6	0·9		–	–	–	–	–	-f
-	–	–	–	–	–	–	–	–	–	?	45·5	–	–	35·8	6·1	–	–	45·5	–	1·4		–	–	–	–	–	35·8	-g
-	–	–	–	–	–	–	–	–	–	?	?	?	–	?	6·3	–	1·1	44·3	2·4	0·2	1·0	trace	–	–	–	–	9·7	
-	–	–	–	–	–	–	–	–	–	?	4·7	–	–	3·7	84·9	–	–	4·7	–	2·2		–	–	–	?	–	3·7	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	70·1	0·9	–	1·8	0·4	14·5	10·5	–	–	–	–	0·9	0·9	-h
-	–	–	–	–	–	–	?	–	–	6·5	36·0	0·7	–	29·0	26·1	–	–	37·7	0·7	3·1		–	–	–	1·8	–	29·0	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18·8	–	–	–	–	–	–	–	–	–	1·5	–	–	
-	2·7	–	–	–	–	–	?	–	–	23·4	6·4	1·5	–	6·5	50·3	2·7	–	16·3	1·5	9·7		–	–	–	8·5	–	6·5	-i
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	66·0	–	–	–	–	–	–	–	–	–	2·9	–	–	
-	–	–	–	–	–	–	?	–	–	8·1	–	–	–	–	83·6	–	–	2·0	0·2	5·6		–	–	–	0·7	–	5·6	
-	Salts 0·2				–	–	–	with Salts.	?	?	28·0	17·2	0·2	41·0	7·9	Salts 0·2		28·0	17·2	4·7		–	–	–	–	0·2	41·0	
-	–	–	–	–	–	–	–	–	–	?	51·6	0·5	–	41·2	3·1	–	–	51·6	0·5	with Sil.	–	–	–	–	–	–	41·2	
-	–	–	–	–	–	–	–	–	–	?	6·0	–	–	4·7	80·1	–	–	6·1	–	4·1		–	–	–	–	–	4·7	-k
-	–	–	–	–	–	–	–	–	–	–	54·9	0·5	–	43·6	–	–	–	54·9	0·5	1·0		–	–	–	–	–	43·6	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1·8	–	–	–	–	–	–	–	–	–	0·9	–	–	
-	–	–	–	–	–	–	–	–	–	?	54·0	0·5	–	43·0	0·5	–	–	54·0	0·5	0·5		–	–	–	–	–	43·0	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6·3	–	–	–	–	–	–	–	–	–	0·5	–	–	
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
-	–	–	–	–	–	–	–	–	–	7·7	9·1	0·4	–	7·5	10·7	–	–	43·3	0·4	6·0		–	–	–	29·4	–	7·5	-l
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13·8	–	–	–	–	–	–	–	–	–	14·8	–	–	
-	–	–	–	–	–	–	–	–	–	?	15·5	0·2	–	12·4	0·9	–	–	47·5	0·2	–	2·9	–	–	–	24·3	–	12·4	-m
-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
-	–	–	–	–	–	–	–	–	–	3·2	–	0·4	–	0·5	47·1	–	–	24·5	0·4	3·3		–	–	–	20·8	–	0·5	-n

tile clays.——*f*. This analysis includes the famous Stourbridge clay.——*g*. Naturally wet, and long drying.——*h*. Used as rous at Farnham and other places.——*m*. Very scarce. In all the fossils analysed by Professor Way there is a varying quantity

O 2.—EARTHS.

Class.	Species.	Locality.		General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic. Authority.	Number of Analyses.
Alluvial.	River mud	Kirkcudbright.	–	Johnston	2	?	65	2175	– –	–	–	–	–	–	–	–	Johnston	2
		Warp, Trent.	–	Herepath	1	134	148	1958	– –	–	–	–	–	–	–	–	Herepath	1
	Shellsand	Normandy	–	Johnston	1	?	114	2126	Boussingault and Payen.	1	–	–	–	2·9	3·5	–	Johnston	1
		Isla . .	–	Johnston	2	?	?	2240	– –	–	–	–	–	–	–	–	Johnston	2
		Devonsh.	(coral)	Herepath	1	11	54	2175	Boussingault and Payen.	1	–	–	–	11·4	13·8	–	Herepath	1
	Clay . . .	Portobello		Cameron	1	193		2047	– –	–	–	–	–	–	–	–	Cameron	1
Crag	Red Coralline	Various .	–	Nesbit .	7	?	?	2240	– –	–	–	–	–	–	–	–	Nesbit .	7
Clays.	Pipeclay .	Devonsh.	–	Johnston	1	251	–	1989	– –	–	–	–	–	–	–	–	Johnston	1
	Porcelain .	Meissen .	–	Liebig .	2		2240		– –	–	–	–	–	–	–	–	Liebig .	2
	Tile . .	Dunferline	–	Jones . .	1	63	112	2065	– –	–	–	–	–	–	–	–	Jones .	1
		Ayrshire	–	Fromberg	5	121		2119	– –	–	–	–	–	–	–	–	Fromberg	5
	Fire . . .	Various .	–	Johnston	4	188	–	2052	– –	–	–	–	–	–	–	–	Johnston	4
Marls.	Peat . .	Forfarshire	–	Johnston	3	?	251	1989	– –	–	–	–	–	–	–	–	Johnston	3
		Forfarshire	–	Colvill .	1	?	784	1456	– –	–	–	–	–	–	–	–	Colvill .	1
	Clay . .	Ayrshire	–	Johnston	1	31	63	2146	– –	–	–	–	–	–	–	–	Johnston	1
		Cornwall	–	Hunt . .	2	?	?	2240	– –	–	–	–	–	–	–	–	Hunt . .	2
	Chalk .	Farnham	–	Way . .	1	?	?	2240	– –	–	–	–	–	–	–	–	Way . .	1
		– –	–	Nesbit .	3	?	?	2240	– –	–	–	–	–	–	–	–	Nesbit .	3
	Upper Greensand.	Farnham	–	Way . .	4	?	101	2139	– –	–	–	–	–	–	–	–	Way . .	4
		– –	–	Nesbit .	1		2240		– –	–	–	–	–	–	–	–	Nesbit .	1
	Lower Greensand.	Farnham	–	Way . .	1	?	52	2188	– –	–	–	–	–	–	–	–	Way . .	1
	Magnesian.	Sutherland-shire.	–	Johnston	1	?	?	2240	– –	–	–	–	–	–	–	–	Johnston	1
	Powdery	Boyne .	(white)	Johnston	1	34	31	2175	– –	–	–	–	–	–	–	–	Johnston	1
		Boyne .	(blue)	Johnston	1	45	25	2170	– –	–	–	–	–	–	–	–	Johnston	1
Chalk.	Upper .	Meudon .	–	Berthier .	1	?	–	2240	– –	–	–	–	–	–	–	–	Berthier .	1
		– –	–	Nesbit .	2		2240		– –	–	–	–	–	–	–	–	Nesbit .	2
	Lower .	Maestricht	–	Römer .	1	34	–	2206	– –	–	–	–	–	–	–	–	Römer .	1
		– –	–	Nesbit .	7		2240		– –	–	–	–	–	–	–	–	Nesbit .	7
Greensand.	Upper Greensand.	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Fossils in ditto.	Farnham	–	Way . .	4	?	60	2180	– –	–	–	–	–	–	–	–	Way . .	4
		Isle of Wight, &c.	–	Nesbit .	23		2240		– –	–	–	–	–	–	–	–	Nesbit .	23
	Gault Fossil	Farnham	–	Way . .	1	199	65	1976	– –	–	–	–	–	–	–	–	Way . .	1
	Lower Greensand.	– –	–	– –	–	–	–	–	– –	–	–	–	–	–	–	–	– –	–
	Fossils in do.	Farnham	–	Way . .	1	?	76	2164	– –	–	–	–	–	–	–	–	Way . .	1

a Warp from the river

O 2.—EARTHS.

PER TON IN POUNDS.

Matter or Ash.

Total Sulphur.	Soluble in Rain Water. Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia	Iron.	Phospho. Acid.	Sulphuric Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–		Salts. 11			–	–	–	with Salts	?	?	92	13	4	83	1857	Salts. 11		92	13	42	80	–	with Salts		–	4	83	–a
–	–	–	–	–	–	–	–	–	–	?	108	14	trace	108	1454	2		130	72	94	94	trace	–	–	0·9	trace	108	
–	–	7	Chl. 27		–	–	–	–	–	?	553	trace	5	428	1069	–	7	553	trace	5	27	trace	Chl. 27		–	5	428	
–	–	–	–	–	–	–	?	–	–	?	392	–	–	305	1539	–	?	392	–	with Silica		–	–	?	4	–	305	
–	–	Salts 7	–	with Salts	–	–	?	–	?	?	594	1	trace	468	1093	trace	Salts 7	594	1	1		–	–	with Salts	0·2	trace	468	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1209	34		16	36	571	181	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1111	–	–	–	–	838	–	–	–	–	–	–	–	
–	?	–	–	–	–	–	–	–	–	?	–	–	–	–	1116	54	–	–	–	766	–	–	–	–	–	–	–	
–	20	9	–	–	–	–	?	–	–	42	25	7	31	9	1436	42	15	40	20	302	170	trace	–	–	–	31	9	
–	?	?	–	–	–	–	–	–	–	?	?	?	?	?	1331	87		23	23	475	161	–	–	–	–	?	?	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1178	–	–	29	5	820		20	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	?	1019	–	–	802	137	–	–	1019	–	31		–	–	–	–	–	802	
–	–	?	–	–	–	–	–	–	–	?	?	?	–	?	141	–	25	992	54	5	22	trace	–	–	–	–	217	
–	–	–	–	–	–	–	–	–	–	?	105	–	–	83	1902	–	–	105	–	49		–	–	–	?	–	83	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1570	20	–	40	9	325	235	–	–	–	–	20	20	
–	–	–	–	–	–	–	?	–	–	146	806	16	–	650	585	–	–	845	16	70		–	–	–	40	–	650	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	421	–	–	–	–	–	–	–	–	–	34	–	–	
–	60	–	–	–	–	–	?	–	–	524	143	34	–	146	1127	60	–	365	34	217		–	–	–	190	–	146	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1479	–	–	–	–	–	–	–	–	–	65	–	–	
–	–	–	–	–	–	–	?	–	–	182	?	?	–	?	1875	–	–	45	4	125		–	–	–	16	–	125	
–		Salts 5			–	–	–	with Salts	?	?	627	385	5	919	177	Salts 5		627	385	105		–	–	–	–	5	919	
–	–	–	–	–	–	–	–	–	–	?	1156	11	–	923	70	–	–	1156	11	with Sil.	–	–	–	–	–	–	923	
–	–	–	–	–	–	–	–	–	–	?	137	–	–	105	1794	–	–	137	–	92		–	–	–	–	–	105	
–	–	–	–	–	–	–	–	–	–	–	1230	11	–	977	–	–	–	1230	11	22		–	–	–	–	–	977	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	40	–	–	–	–	–	–	–	–	–	20	–	–	
–	–	–	–	–	–	–	–	–	–	?	1210	11	–	963	11	–	–	1210	11	11		–	–	–	–	–	963	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	141	–	–	–	–	–	–	–	–	–	11	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	?	–	–	173	204	9	–	168	240	–	–	970	9	134		–	–	–	659	–	168	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	309	–	–	–	–	–	–	–	–	–	332	–	–	
–	–	–	–	–	–	–	?	–	–	?	347	5	–	278	20	–	–	1064	5	–	65	–	–	–	544	–	278	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	72	–	9	–	11	1055	–	–	549	9	74		–	–	–	466	–	11	

Trent, dried in the air.

P 1.—SOILS (I.).

Class.	Species.	Locality.	Stones, Sand, &c.	Fine Matter.	General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE Organic Ultimate Authority.	Number of Analyses.	Carbon.	Hydrogen.
Peat.	Drained . .	Lewes . . .	–	–	Johnston . .	1	?	93·7	6·3	– –	–	–	–
	Undrained .				Johnston . .	1	?	97·5	2·5	– –	–	–	–
	Drained . .	Holland . .	–	–	Johnston . .	1	?	86·5	13·5	Johnston .	1	–	–
	Undrained .				Johnston . .	1	?	63·5	36·5	Johnston .	1	–	–
Alluvial.	Black earth .	Russia . . .	–	–	Payen . . .	1	?	7·0	93·0	Payen . .	1	–	–
	Do., 10 ft. deep	Ditto . . .	–	–	Phillips . .	1	?	6·4	93·6	– –	–	–	–
	Recent . .	Forth . . .	–	–	Johnston . .	1	?	6·3	93·7	– –	–	–	–
	Carse . . .	Stirling . . .	0·5	99·5	Thomson . .	1	?	5·0	95·0	– –	–	–	–
	Carse . . .	Stirling . . .	8·6	91·4	Thomson . .	1	?	7·6	92·4	– –	–	–	–
Clays.	Stiff . . .	Whitehill, Mid Lothian.	46·2	53·8	Johnston . .	1	?	4·1	95·9	– –	–	–	–
	Ditto . . .		50·0	50·0	Johnston . .	1	?	7·1	92·9	– –	–	–	–
	Ditto . . .		49·9	50·1	Johnston . .	1	?	7·1	92·9	– –	–	–	–
	Medium .		68·2	31·8	Johnston . .	1	?	6·9	93·1	– –	–	–	–
	Light . .		77·6	22·4	Johnston . .	1	?	11·5	88·5	– –	–	–	–
	Ditto . .		77·7	22·3	Johnston . .	1	?	7·1	92·9	– –	–	–	–
	Soft . . .	Ditto . . .	36·0	64·0	Johnston . .	1	?	6·6	93·4	– –	–	–	–
	Strong . .	?	34·0	66·0	Gyde . . .	1	?	9·3	90·7	– –	–	–	–
		?	41·2	58·8	Gyde . . .	1	?	4·4	95·6	– –	–	–	–
		?	?	?	Gyde . . .	1	?	4·5	95·5	– –	–	–	–

P 1.—SOILS (I.).

COMPOSITION PER CENT.															
Matter.				Inorganic Matter or Ash.											
Elements.							Soluble in Rainwater.								
							Abundantly.								
Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chloride Potass.	Chloride Sodium.	Magnesia	Iron.	Phosph. Acid.	Sulphuric Acid.	Carbonic Acid.
–	–	–	–	Johnston . .	1	–	?		–	0·03	0·04	–	?	0·07	?
–	–	–	–	Johnston . .	1	–	?		–	0·008	0·02	–	?	0·04	?
–	–	–	6·56	– –	–	–	–	–	–	–	–	–	–	–	–
–	–	–	14·62	– –	–	–	–	–	–	–	–	–	–	–	–
–	2·45	2·97	–	Payen . . .	1	–	–	–	1·21		–	–	–	–	–
–	–	–	–	Phillips . .	1	–	–	–	–	–	–	–	–	–	–
–	–	–	–	Johnston . .	1	–	salts 0·77		0·08		–	–	–	with salts	?
–	–	–	–	Thomson . .	1	–	salts 0·40				–	–	?	with salts	?
–	–	–	–	Thomson . .	1	–	salts 0·40				–	–	–	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·12				–	–	–	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·06				–	–	–	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·11				–	–	–	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·25				–	–	–	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·49				–	–	–	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·45				–	–	?	with salts	?
–	–	–	–	Johnston . .	1	–	salts 0·20				–	–	–	with salts	?
–	–	–	–	Gyde . . .	1	–	salts 0·17				–	–	?	with salts	?
–	–	–	–	Gyde . . .	1	–	salts 0·11				–	–	?	with salts	?
–	–	–	–	Gyde . . .	1	–	salts 0·11				–	–	?	with salts	?

P 1, *continued*—SOILS (I).

Class.	Species.	Locality.	Authority.	Number of Analyses.	ENTIRE — Inorganic — Soluble in Rainwater. — Sparingly. — Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.
Peat.	Drained	Lewes	Johnston	1	0·98	0·74	?	1·06	?
	Undrained		Johnston	1	0·72	0·17	?	0·25	?
	Drained	Holland	— —	–	–	–	–	–	–
	Undrained		— —	–	–	–	–	–	–
Alluvial.	Black earth	Russia	Payen	1	?	?	?	?	?
	Do., 10 feet deep	Ditto	Phillips	1	–	–	–	–	–
	Recent	Forth	Johnston	1	?	0·65	1·00	0·25	1·43
	Carse	Stirling	Thomson	1	?	3·6	?	–	2·8
	Carse	Stirling	Thomson	1	?	0·39	?	–	0·31
Clays.	Stiff	Whitehill, Mid Lothian.	Johnston	1	0·07	0·54	0·25	0·06	0·70
	Ditto		Johnston	1	0·06	0·54	0·30	0·05	0·73
	Ditto		Johnston	1	–	1·30	0·40	0·06	1·40
	Medium		Johnston	1	0·03	0·43	0·20	0·035	0·53
	Light		Johnston	1	–	0·64	0·30	0·05	0·80
	Ditto		Johnston	1	–	1·04	0·10	0·05	0·90
	Soft	Ditto	Johnston	1	0·17	1·34	0·5	0·05	1·5
	Strong	?	Gyde	1	?	4·22	0·06	trace	3·28
		?	Gyde	1	?	0·84	0·44	0·08	1·0
		?	Gyde	1	?	2·26	trace	trace	1·81

a. The Sand and Silica column, in the majority of instances, includes all the matter insoluble in

P 1, *continued*—SOILS (I.).

COMPOSITION PER CENT.—*continued.*

Matter or Ash—*continued.*

Total Inorganic Matter.

Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
1·48	0·33		0·81	0·45	0·70	0·58	–	–	0·03	0·09	1·13	0·68	–*a*
1·07	0·09		0·25	0·17	0·19	0·17	–	–	0·008	0·09	0·29	0·20	
–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	–	–	
71·60	–	–	0·8	1·2	11·4	5·6	–	1·21		?	?	?	–*b*
69·8	–	–	1·6	–	13·5	7·0	–			1·7			
77·0	salts 0·77		0·65	1·0	6·6	6·3	–	0·08		–	0·25	1·43	
67·7	salts 0·4		3·6	3·3	13·2	3·0	–	with salts		0·8	with salts	2·8	
62·7	salts 0·4		0·39	1·9	14·3	11·2	–	with salts		1·0	with salts	0·31	
87·4	salts 0·12		0·54	0·25	1·3	5·0	–	with salts		–	0·06	0·70	
84·8	salts 0·06		0·54	0·30	1·5	5·1	–	with salts		–	0·05	0·73	
84·3	salts 0·11		1·30	0·40	1·3	4·0	–	with salts		–	0·06	1·40	
86·9	salts 0·25		0·43	0·20	1·5	3·6	–	with salts		–	0·035	0·53	–*c*
77·0	salts 0·49		0·64	0·30	5·4	4·4	–	with salts		–	0·05	0·80	
77·8	salts 0·45		1·04	0·10	6·2	5·0	–	with salts		trace	0·05	0·90	
83·5	salts 0·20		1·34	0·5	1·1	4·5	–	with salts		–	0·05	1·5	
65·0	salts 0·17		4·22	0·06	12·8	5·0	–	with salts		0·08	trace	3·28	
74·1	salts 0·11		0·84	0·44	13·3	1·4	–	with salts		0·10	0·08	1·00	–*d*
78·7	salts 0·11		2·26	trace	10·8	1·3	–	with salts		0·08	trace	1·81	

acids.——*b.* This soil is never manured.——*c.* On coal formation.——*d.* Good wheat and bean soils.

P 1, *continued*—SOILS (I.).

					General Division.					ENTIRE			
					Dried at 212° Fahr.					Organic			
										Ultimate			
Class.	Species.	Locality.	Stones, Sand, &c.	Fine Matter.	Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.
Loam.	Strong	East Denton	?	?	Richardson	1	14·4740	9·1439	76·3821	– –	–	–	–
	Clay	Renfrew-shire.	26·3	73·7	Johnston .	1	?	10·4	89·6	– –	–	–	–
	Ditto	Ditto . .	37·7	62·3	Johnston .	1	?	12·1	87·9	– –	–	–	–
	Light	Mid-Lothian	70·8	29·2	Johnston .	1	?	4·5	95·5	– –	–	–	–
	Sandy	Ditto . .	69·4	30·6	Johnston .	1	?	9·2	90·8	– –	–	–	–
Sands.	Sandy	Mid-Lothian	76·0	24·0	Johnston .	1	?	8·5	91·5	– –	–	–	–
	Sandy	River Trent	97·0	3 0	Herepath .	1	1·06	2·20	96·7	Herepath .	1	–	–
Waste Land.	Unreclaimed . .	Hayle, Cornwall.	–	–	Hunt . .	1	?	8·0	92·0	Hunt . .	1	–	–
	Reclaimed without Bones.	Trelyon Common, Cornwall.	–	–	Hunt . .	1	?	21·0	79·0	Hunt . .	1	–	–
	Ditto Reclaimed 10 years with Bones.	,,	–	–	Hunt . .	1	?	21·2	78·8	Hunt . .	1	–	–
Soils from Disintegrated Rocks.	Grauwacke . .	Balkerr, Wigton-shire.	25·6	74·4	Thomson .	1	?	13·5	86·5	– –	–	–	–
		Turriff . .	66·8	33·2	Shier . .	1	3·3	7·3	89·4	Shier . .	1	–	–
	Greenstone . .	?	?	?	Thomson .	1	5·0	10·7	84·3	– –	–	–	–
		King's Park, Stirling.	25·1	74·9	Thomson .	1	?	15·8	84·2	– –	–	–	–
		Ditto Subsoil	20·0	80·0	Thomson .	1	?	9·4	90·6	– –	–	–	–
	Sandstone (Old Red).	Turriff . .	62·0	38·0	Shier . .	1	3·5	10·7	85·8	Shier . .	1	–	–
		Turriff . .	55·8	44·2	Shier . .	1	2·7	7·4	89·9	Shier . .	1	–	–
	Slate	Castle Douglas	44·0	56·0	Johnston .	1	?	10·4	89·6	– –	–	–	–
			18·0	82·0	Johnston .	1	?	10·2	89·8	– –	–	–	–
			80·0	20·0	Johnston .	1	?	9·4	90·6	– –	–	–	–
	Shale	Craiglockhart	?	?	Anderson .	1	?	6·6	93·4	– –	–	–	–

P 1, *continued*—SOILS (I.).

COMPOSITION PER CENT.															
Matter.							Inorganic Matter or Ash.								
Elements.							Soluble in Rain Water.								
							Abundantly.								
Oxygen.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chl. of Potas.	Chl. of Sodium.	Magnesia	Iron.	Phos. Acid.	Sulph. Acid.	Carb. Acid.
–	–	–	–	Richardson .	1	–	0·0641	0·0147	Chl. 0·0711		0·0166	–	–	?	?
–	–	–	–	Johnston . .	1	–		Salts 0·75			–	–	–	with Salts	?
–	–	–	–	Johnston . .	1	–		Salts 1·23			–	–	–	,,	?
–	–	–	–	Johnston . .	1	–		Salts 0·11			–	–	–	,,	?
–	–	–	–	Johnston . .	1	–		Salts 0·13			–	–	–	,,	?
–	–	–	–	Johnston . .	1	–		Salts 0·21			–	–	–	with Salts	?
–	0·072	0·087	1·61	Herepath .	1	–	–	0·003	0·0017	0·0055	trace	–	–	0·004	–
–	–	–	3·0	Hunt . . .	1	–	?	?	–	–	–	–	–	–	–
–	–	–	7·0	Hunt . . .	1	–	?	?	0·63		–	–	?	–	–
–	–	–	7·2	Hunt . . .	1	–	?	?	0·64		–	–	?	–	–
–	–	–	–	Thomson. .	1	–		Salts 0·06			–	–	?	with Salts	?
–	–	–	0·08	Shier . . .	1	–	?	?	trace		–	–	–	–	–
–	–	–	–	Thomson. .	1	–		Salts 1·63			–	–	?	with Salts	?
–	–	–	–	Thomson . .	1	–		Salts 0·06			–	–	?	,,	?
–	–	–	–	Thomson . .	1	–		Salts 0·20			–	–	?	,,	?
–	–	–	0·07	Shier . . .	1	–	?	?	0·034		–	–	–	–	–
–	–	–	0·11	Shier . . .	1	–	?	?	trace		–	–	–	–	–
–	–	–	–	Johnston . .	1	–		Salts 0·91			–	–	–	with Salts	?
–	–	–	–	Johnston . .	1	–		Salts 1·49			–	–	–	,,	?
–	–	–	–	Johnston . .	1	–		Salts 0·29			–	–	–	,,	?
–	–	–	–	Anderson. .	1	–	?	?	–	–	–	?	–	?	–

P 1, *continued*—SOILS (I.).

Class.	Species.	Locality.	Authority.	Number of Analyses.	ENTIRE — Inorganic — Soluble in Rain Water. — Sparingly. — Silic	Lime.	Magnesia	Sulph. Acid.	Carb. Acid.
Loam.	Strong	East Denton	Richardson	1	0·0259	0·1733	?	0·1444	?
	Clay	Renfrewshire	Johnston	1	?	0·8	trace	–	0·6
	Ditto	Ditto	Johnston	1	?	0·6	trace	–	0·5
	Light	Midlothian	Johnston	1	0·03	0·4	0·2	0·04	0·5
	Sandy	Ditto	Johnston	1	–	0·55	0·4	0·024	0·8
Sands.	Sandy	Midlothian.	Johnston	1	0·03	0·6	0·2	0·05	0·6
	Sandy	River Trent	Herepath	1	?	trace	trace	trace	trace
Waste Lands.	Unreclaimed	Hayle, Cornwall.	Hunt	1	?	2·20	0·03	0·80	1·34
	Reclaimed without Bones.	Trelyon Common, Cornwall.	Hunt	1	?	1·30	0·14	0·7	0·7
	Ditto Reclaimed 10 years with Bones.	,,	Hunt	1	?	1·1	0·2	0·7	0·7
Soils from Disintegrated Rocks.	Grauwacke	Balkerr, Wigtonshire.	Thomson	1	?	0·41	?	?	0·33
		Turriff	Shier	1	?	0·10	?	0·044	0·05
	Greenstone	?	Thomson	1	?	?	?	?	?
		King's Park, Stirling.	Thomson	1	?	0·42	?	–	0·33
		Ditto Subsoil	Thomson	1	?	0·66	?	?	0·51
	Sandstone (Old Red)	Turriff	Shier	1	?	0·04	?	trace	0·03
		Turriff	Shier	1	?	0·13	?	0·025	0·09
	Slate	Castle Douglas.	Johnston	1	?	0·28	0·88	0·05	1·16
			Johnston	1	?	0·33	0·56	0·05	0·85
			Johnston	1	?	0·02	0·67	0·03	0·74
	Shale	Craiglockhart	Anderson	1	0·02		?	?	?

a. This analysis is a specimen of a very minute investigation, although it has no advantages over one less laborious, as same soil ever agreed within $\frac{1}{10}$ per cent., much less $\frac{1}{10000}$. N.B. The above soil was only dried in the air.——*e.* Medium.——*f.* Barren. There was 0·6 per cent. of lime in the form of insoluble silicate.——*g.* Clover always

P 1, *continued*—SOILS (I.).

COMPOSITION PER CENT.—*continued.*

Matter or Ash—*continued.*

Total Inorganic Matter.

Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
62·8152	1·0241	0·4317	1·1311	0·2958	7·2550	2·8927	–	Chl. 0·0711		0·3216	0·1444	?	–*a*
73·2	Salts 0·75		0·8	trace	2·9	10·8	0·24	with Salts		trace	with Salts	0·6	
74·4	Salts 1·23		0·6	trace	4·7	5·7	0·20	with Salts		,,	,,	0·5	
90·2	Salts 0·11		0·4	0·2	0·7	2·9	–	with Salts		–	0·04	0·5	
84·1	Salts 0·13		0·55	0·4	0·8	3·6	–	with Salts		trace	0·024	0·8	
85·6	Salts 0·21		0·6	0·2	1·1	2·6	–	with Salts		–	0·05	0·6	
96·06	minute trace	0·003	0·0007	trace	0·39	0·277	trace	0·0017	0·0055	0·00005	0·004	trace	–*b*
63·2	1·0	0·005	2·25	0·03	10·0	12·4	0·01	–	–	0·05	0·80	1·34	
57·6	1·2	–	1·37	0·14	8·3	8·5	–	0·63		0·07	0·7	0·7	–*c*
57·6	1·5	–	1·6	0·2	7·0	8·2	–	0·64		0·46	0·7	0·7	
64·3	Salts 0·06		1·0	2·4	8·3	8·9	–	with Salts		1·25	?	0·33	
81·8	0·26	0·41	0·21	0·14	4·2	1·7	0·52	trace		0·03	0·044	0·05	
50·0	Salts 1·63		2·64	4·2	5·6	17·0	–	with Salts		3·10	with Salts	?	
54·4	Salts 0·06		1·28	–	2·7	19·4	–	with Salts		4·80	,,	0·33	
57·7	Salts 0·20		2·26	2·0	4·8	19·3	–	with Salts		3·70	,,	0·51	
79·2	0·26	0·31	0·31	0·07	3·8	1·6	0·23	0·034		trace	trace	0·03	
79·3	0·16	0·42	0·49	0·06	6·3	2·1	0·90	trace		0·04	0·025	0·09	
75·4	Salts 0·91		0·28	0·88	5·5	5·6	–	with Salts		–	0·05	1·16	–*d*
80·3	Salts 1·49		0·33	0·56	3·4	3·7	–	with Salts		–	0·05	0·85	–*e*
81·3	Salts 0·29		0·02	0·67	3·1	4·6	–	with Salts		–	0·03	0·74	–*f*
85·9	0·24	0·02	0·33	0·27	1·8	4·7	–	–	–	0·14	0·01	trace	–*g*

far as practical purposes are concerned, except as regards the division of the soluble salts, for no two analyses of the *b*. Sterile soil.——*c*. The chemist was not aware that bones had been applied to one portion.——*d*. Best soil.—— succeeded.

P 2—SOILS (I.).

Class.	Species.	Locality.	Stone, Coarse Sand.	Fine Matter.	General Division. Dried at 212° Fahr. Authority	Number of Analyses.	Water.	Organic Matter.	Ash.[a]	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic. Authority	Number of Analyses.	Total Sulphur.
Peat.	Drained	Lewes .	–	–	Johnston	1	?	56220	3780	– –	–	–	–	–	–	–	–	Johnston	1	–
	Undrained	Lewes .	–	–	Johnston	1	?	58500	1500	– –	–	–	–	–	–	–	–	Johnston	1	–
	Drained	Holland	–	–	Johnston	1	?	51900	8100	Johnston	1	–	–	–	–	–	3936	– –	–	–
	Undrained	Holland	–	–	Johnston	1	?	38100	21900	Johnston	1	–	–	–	–	–	8772	– –	–	–
Alluvial.	Black earth	Russia .	–	–	Payen .	1	?	4200	55800	Payen .	1	–	–	–	–	–	–	Payen .	1	–
	Ditto 10 ft. deep.	Russia .	–	–	Phillips	1	?	3840	56160	– –	–	–	–	–	–	–	–	Phillips	1	–
	Recent .	Forth .	–	–	Johnston	1	?	3780	56220	– –	–	–	–	–	–	–	–	Johnston	1	–
	Carse 1	Stirling .	300	59700	Thomson	1	?	3000	57000	– –	–	–	–	–	–	–	–	Thomson	1	–
	Carse 2	Stirling .	5160	54840	Thomson	1	?	4560	55440	– –	–	–	–	–	–	–	–	Thomson	1	–
Clays.	Stiff . .	Whitehill Mid-Lothian.	27720	32280	Johnston	1	?	2460	57540	– –	–	–	–	–	–	–	–	Johnston	1	–
	Ditto .	Whitehill Mid-Lothian.	30000	30000	Johnston	1	?	4260	55740	– –	–	–	–	–	–	–	–	Johnston	1	–
	Ditto .	Whitehill Mid-Lothian.	29940	30060	Johnston	1	?	4260	55740	– –	–	–	–	–	–	–	–	Johnston	1	–
	Medium	Whitehill Mid-Lothian.	40920	19080	Johnston	1	?	4140	55860	– –	–	–	–	–	–	–	–	Johnston	1	–
	Light .	Whitehill Mid-Lothian.	46560	13440	Johnston	1	?	6900	53100	– –	–	–	–	–	–	–	–	Johnston	1	–
	Ditto .	Whitehill Mid-Lothian.	46620	13380	Johnston	1	?	4260	55740	– –	–	–	–	–	–	–	–	Johnston	1	–
	Soft . .	Ditto . .	21600	38400	Johnston	1	?	3960	56040	– –	–	–	–	–	–	–	–	Johnston	1	–
	Strong .	?	20400	39600	Gyde .	1	?	5580	54420	– –	–	–	–	–	–	–	–	Gyde .	1	–
	Strong .	?	24720	35280	Gyde .	1	?	2640	57360	– –	–	–	–	–	–	–	–	Gyde .	1	–
	Strong .	?	–	–	Gyde .	1	?	2700	57300	– –	–	–	–	–	–	–	–	Gyde .	1	–

a. The weight of an average acre of soil one foot deep is 3000 tons, according to the mean specific gravity of 16
but not having the specific gravity of it, I thought

P 2—SOILS (I.).

PER STATUTE ACRE IN CWTS.—1 FOOT DEEP.

Matter or Ash.

Soluble in Rain Water.														Total Inorganic Matter.												
Abundantly.									Sparingly.																	
Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
?		–	18	24	–	?	42	?	588	444	?	636	?	888	198		486	270	420	348	–	–	18	54	678	408 -a
?		–	5	12	–	?	24	?	432	102	?	150	?	642	54		150	102	114	102	–	–	5	54	174	120
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	726		–	–	–	–	–	?	?	?	?	?	42960	–	–	480	720	6840	3360	–	726		?	?	?
–	–	–	–	–	–	–	–	–	–	–	–	–	–	41880	–	–	960	–	8100	4200	–	1020				
Salts. 462		48		–	–	–	with salts	?	?	390	600	150	858	46200	Salts. 462		390	600	3960	3780	–	48		–	150	858
Salts. 240				–	–	?	,,	?	?	2160	?	–	1680	40620	Salts. 240		2160	1980	7920	1800	–	with Salts		480	with Salts.	1680
Salts. 240				–	–	?	,,	?	?	234	?	–	186	37620	Salts. 240		234	1140	8580	6720	–	with Salts		600	,,	186
Salts. 72				–	–	–	with salts	?	42	324	150	36	420	52440	Salts. 72		324	150	780	3000	–	with Salts		–	36	420
Salts. 36				–	–	–	,,	?	36	324	180	30	438	50880	Salts. 36		324	180	900	3060	–	with Salts		–	30	438
Salts. 66				–	–	–	,,	?	–	780	240	36	840	50580	Salts. 66		780	240	780	2400	–	with Salts		–	36	840
Salts. 150				–	–	–	,,	?	18	258	120	21	318	52140	Salts. 150		258	120	900	2160	–	with Salts		–	21	318
Salts. 294				–	–	–	,,	?	–	384	180	30	480	46200	Salts. 294		384	180	3240	2640	–	with Salts		–	30	480
Salts. 270				–	–	–	,,	?	–	624	60	30	540	46680	Salts. 270		624	60	3720	3000	–	with Salts		–	30	540
Salts. 120				–	–	–	,,	?	102	804	300	30	900	50100	Salts. 120		804	300	660	2700	–	with Salts		–	30	900
Salts. 102				–	–	?	,,	?	?	2532	36	trace	1968	39000	Salts. 102		2532	36	7680	3000	–	with Salts		48	trace	1968
Salts. 66				–	–	?	,,	?	?	504	264	48	600	44460	Salts. 66		504	264	7980	840	–	with Salts		60	48	600
Salts. 66				–	–	?	,,	?	?	1356	trace	trace	1086	47220	Salts. 66		1356	trace	6480	780	–	with Salts		48	trace	1086

varieties of soil, as ascertained by Dr. Krocker, which was 2·44. This is nearly twice too great a weight for peat, it better to adhere to one general rule.

P 2, *continued*—SOILS (I.).

					General Division.					ENTIRE COMPOSITIO[N]										
					Dried at 212° Fahr.					Organic Matter.								Inorgani[c]		
										Ultimate Elements.										
Class.	Species.	Locality.	Stone, Coarse Sand.	Fine Matter.	Authority	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Authority	Number of Analyses.	Total Sulphur.
Loams.	Strong .	East Denton.	air dried.		Richard-son.	1	8685	5486	45829	– –	–	–	–	–	–	–	–	Richard-son.	1	–
	Clay .	Renfrew-shire.	15780	44220	Johnston	1	?	6240	53760	– –	–	–	–	–	–	–	–	Johnston	1	–
	Ditto .	Ditto . .	22620	37380	Johnston	1	?	7260	52740	– –	–	–	–	–	–	–	–	Johnston	1	–
	Light .	Mid-Lothian.	42480	17520	Johnston	1	?	2700	57300	– –	–	–	–	–	–	–	–	Johnston	1	–
	Sandy .	Ditto . .	41640	18360	Johnston	1	?	5520	54480	– –	–	–	–	–	–	–	–	Johnston	1	–
Sandy	Sandy .	Mid-Lothian.	45600	14400	Johnston	1	?	5100	54900	– –	–	–	–	–	–	–	–	Johnston	1	–
	Sandy .	River Trent	–	–	Herepath	1	636	1320	58044	Herepath	1	–	–	–	43·2	52·2	966	Herepath	1	–
Waste Land.	Unre-claimed.	Hayle, Cornwall.	–	–	Hunt .	1	?	4800	55200	Hunt .	1	–	–	–	–	–	1800	Hunt .	1	–
	Re-claimed, without bones.	Trelyon Common, Cornwall.	–	–	Hunt .	1	?	12600	47400	Hunt .	1	–	–	–	–	–	4200	Hunt .	1	–
	Ditto re-claimed, 10 years with bones.		–	–	Hunt .	1	?	12720	47280	Hunt .	1	–	–	–	–	–	4320	Hunt .	1	–
Soils from Disintegrated Rocks.	Grau-wacke.	Balkerr, Wigton-shire.	15360	44640	Thomson	1	?	8100	51900	– –	–	–	–	–	–	–	–	Thomson	1	–
		Turriff .	40080	19920	Shier .	1	1980	4380	53640	Shier .	1	–	–	–	–	–	48	Shier .	1	–
	Green-stone.	?	–	–	Thomson	1	3000	6420	50580	– –	–	–	–	–	–	–	–	Thomson	1	–
		King's Park Stirling.	15060	44940	Thomson	1	?	9480	50520	– –	–	–	–	–	–	–	–	Thomson	1	–
		Ditto sub-soil.	12000	48000	Thomson	1	?	5640	54360	– –	–	–	–	–	–	–	–	Thomson	1	–
	Sand-stone (old Red.)	Turriff .	47200	22800	Shier .	1	2100	6420	51480	Shier .	1	–	–	–	–	–	42	Shier .	1	–
		Turriff .	33480	26520	Shier .	1	1620	4440	53940	Shier .	1	–	–	–	–	–	66	Shier .	1	–
	Slate .	Castle Douglas	26400	33600	Johnston	1	?	6240	53760	– –	–	–	–	–	–	–	–	Johnston	1	–
			10800	49200	Johnston	1	?	6120	53880	– –	–	–	–	–	–	–	–	Johnston	1	–
			48000	12000	Johnston	1	?	5640	54360	– –	–	–	–	–	–	–	–	Johnston	1	–
	Shale .	Craiglock-hart.	–	–	Anderson	1	?	3960	56040	– –	–	–	–	–	–	–	–	Anderson	1	–

a. The reason of the large quantities of potash and soda in this analysis is on account of the portion insoluble in acid acid than was ever applied in the shape of bones, which may be accounted for by supposing, which

P 2, *continued*—SOILS (I.).

PER STATUTE ACRE IN CWTS.—1 FOOT DEEP.

Matter or Ash.

Soluble in Rain Water.														Total Inorganic Matter.													
Abundantly.									Sparingly.																		
Potash.	Soda.	Chloride of Potass.	Chloride of Sodium	Magnesia	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
39	9	Chl. 43		10	–	–	?	?	15	104	?	87	?	37689	614	259	679	177	4353	1736	–	Chl. 43		193	87	?	–*a*
Salts. 450				–	–	–	with Salts.	?	?	480	trace	–	360	43920	Salts. 450		480	trace	1740	6480	144	with Salts		trace	with Salts.	360	
Salts. 738				–	–	–	,,	?	?	360	trace	–	300	44640	Salts. 738		360	trace	2820	3420	120	with Salts		trace	,,	300	
Salts. 66				–	–	–	,,	?	18	240	120	24	300	54120	Salts. 66		240	120	420	1740	–	with Salts		–	24	300	
Salts. 78				–	–	–	,,	?	–	330	240	14	480	50460	Salts. 78		330	240	480	2160	–	with Salts		trace	14	480	
Salts. 126				–	–	–	with Salts.	?	18	360	120	30	360	51360	Salts. 126		360	120	660	1560	–	with Salts		–	30	360	
–	1·8	1·02	3·3	trace	–	–	2·4	–	?	trace	trace	trace	trace	57636	trace	1·8	0·42	trace	234	166	trace	1·02	3·3	0·03	2·4	trace	
?	?	–	–	–	–	–	–	–	?	1320	18	480	804	37920	600	3	1350	18	6000	7440	6	–	–	30	480	804	
?	?	378		–	–	–	–	–	?	780	84	420	420	34560	720	–	822	84	4980	5100	–	378		42	420	420	
?	?	384		–	–	?	?	–	?	660	120	420	420	34560	900	–	960	120	4200	4920	–	384		276	420	420	–*b*
Salts 36				–	–	?	with Salts.	?	?	246	?	?	198	38580	Salts. 36		600	1440	4980	5340	–	with Salts		750	?	198	
?	?	trace		–	–	–	–	–	?	60	?	27	30	49080	156	246	126	84	2520	1020	312	trace		18	27	30	
Salts. 978				–	–	?	with Salts.	?	?	?	?	?	?	30000	Salts. 978		1584	2520	3360	10200	–	with Salts		1860	with Salts.	?	
Salts. 36				–	–	?	,,	?	?	252	–	–	198	32640	Salts. 36		768	–	1620	11640	–	with Salts		2830	,,	?	
Salts 120				–	–	?	,,	?	?	396	?	?	306	34620	Salts. 120		1356	1200	2880	11580	–	with Salts		2220	,,	306	
?	?	0·21		–	–	–	–	–	?	24	?	trace	18	47520	156	186	186	42	2280	960	138	21		trace	trace	18	
?	?	trace		–	–	–	–	–	?	78	?	15	54	47580	96	252	294	36	3780	1260	540	trace		24	15	54	
Salts. 546				–	–	–	with Salts.	?	?	168	528	30	696	45240	Salts. 546		168	528	3300	3360	–	with Salts		–	30	696	
Salts. 894				–	–	–	,,	?	?	198	336	30	510	48180	Salts. 894		198	336	2040	2220	–	with Salts		–	30	510	
Salts. 174				–	–	–	,,	?	?	12	402	18	444	48780	Salts. 174		12	402	1860	2760	–	with Salts		–	18	444	
?	?	–	–	–	?	–	?	–	12	?	?	?	?	51540	144	12	198	162	1080	2820	–	–	–	84	6	trace	

having been analysed, and which was not in the others.——*b*. This is, of course, a much larger quantity of phosphoric is most probable, that the bones were not *equally* mixed with the soil to the depth of one foot.

P 3.—SOILS (II.).

	Species.	Locality.	Stones, Coarse Sand.	Fine Matter.	General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE. Organic Matter. Authority.	No. of Analyses	Nitrogen.	Ammonia.	Soluble Organic Matter.	Inorganic. Authority.	Number of Analyses	Total Sulphur.	Soluble in Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium
Clover.	Succeeded	Same field	-	–	Anderson	1	2·5	4·1	93·4	Anderson	1	0·15	0·18	0·27	Anderson	1	–	?	?	Chl. trace	
	Failed .		-	–	Anderson	1	2·5	4·1	93·4	Anderson	1	0·15	0·18	0·31	Anderson	1	–				
	Succeeded	Same field	-	–	Anderson	1	3·3	3·4	93·3	Anderson	1	0·21	0·25	0·67	Anderson	1	–				
	Failed .		-	–	Anderson	1	3·3	4·3	92·4	Anderson	1	0·21	0·25	0·87	Anderson	1	–				
Flax.	Good Irish.	Counties London-derry and Tyrone.	-	–	Sir R. Kane	1	?	5·2	94·8	Sir R. Kane	1	?	?	–	Sir R. Kane	1	–				
			-	–	Sir R. Kane	1	?	7·5	92·5	Sir R. Kane	1	?	?	–	Sir R. Kane	1	–				
			-	–	Sir R. Kane	1	?	10·3	89·7	Sir R. Kane	1	?	?	–	Sir R. Kane	1	–				
	Best Dutch.	Courtrai	-	–	Hodges .	1	?	4·7	95·3	Hodges .	1	?	?	–	Hodges .	1	–				
		Lokeren	-	–	Hodges .	1	?	3·3	96·7	Hodges .	1	?	?	–	Hodges .	1	–				
		Ypres .	-	–	Hodges .	1	?	6·0	94·0	Hodges .	1	?	?	–	Hodges .	1	–				
Very Fertile.	Surface	Sutton, Norfolk.	-	–	Playfair .	1	2·6	2·4	95·0	– –	–	–	–	–	Playfair .	1	–	?	?	–	trace
	Subsoil		-	–	Playfair .	1	2·6	1·2	96·2	– –	–	–	–	–	Playfair .	1	–	?	?	–	2·08
	Alluvial	Horn-church, Essex.	-	–	Ure . .	1	3·0	7·4	89·6	Ure . .	1	0·14	0·17	–	Ure . .	1	–	–	–	traces	
Crops Failed.	Barren pasture.	Braydon, North Wilts.	?	100	Way . .	1	?	6·7	93·3	– –	–	–	–	–	Way . .	1	–	?	?	–	–
	Peas rotted.	Lancaster	-	–	Völcker .	1	?	10·0	90·0	Völcker .	1	–	–	0·93	Völcker .	1	6·32		salts 0·62		
	Barley failed.	Lyne-dock, Perth-shire.	-	–	Johnston	1	?	10·0	90·0	– –	–	–	–	–	Johnston	1	–	–	–	trace	
	Barley subsoil.		-	–	Johnston	1	?	2·1	97·9	– –	–	–	–	–	Johnston	1	–		salts trace		
	Oats rotted.	Pam-pherston	-	–	Anderson	1	2·4	8·0	89·6	Anderson	1	–	–	5·71	Anderson	1	–	–	–	–	trace

a. The water mentioned in these four Analyses is, as the reader by this time will probably surmise, in a state of com-
stated as being present.——*b*. All manure sold off the farm during fifty years.——*c*. Remarkable for the large quantity

P 3.—SOILS (II.).

COMPOSITION PER CENT.																							
Matter or Ash.																							
Rain Water.										Total Inorganic Matter.													
Abundantly.					Sparingly.																		
Magnesia.	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
salts 0·46					0·02	?	?	?	?	81·3	0·22	0·09	1·33	0·25	3·0	6·68	–	trace		0·07	0·08	0·34	–*a*
salts 0·44					0·08	?	?	?	?	84·0	0·20	0·07	1·23	0·45	2·4	4·45	–	trace		0·38	0·05	0·09	
salts 0·59					0·33	?	?	?	?	83·6	0·53	0·13	0·70	0·23	2·5	5·18	–	–	–	0·26	0·15	trace	
salts 0·47					trace	?	?	?	?	81·0	0·55	trace	0·85	0·28	3·9	5·61	–	–	–	0·21	0·10	0·18	
salts 0·32					?	0·6	with salts	–	0·5	80·0	salts 0·32		0·6	with salts	7·2	6·0	–	with salts		0·03	with salts	0·5	
salts 0·26					?	0·31	,,	–	0·24	78·5	salts 0·26		0·31	,,	6·5	6·2	–	with salts		0·13	,,	0·24	
salts 0·47					?	1·03	,,	–	0·81	71·0	salts 0·47		1·03	,,	9·8	6·3	–	with salts		0·15	,,	0·81	
salts 0·20					?	0·6	0·1	–	0·6	90·5	salts 0·20		0·6	0·1	1·5	2·0	–	with salts		trace	,,	0·6	
salts 0·14					?	0·31	trace	–	0·24	93·6	salts 0·14		0·31	trace	1·2	1·2	–	with salts		trace	,,	0·24	
salts 0·48					?	0·28	0·25	–	0·49	89·0	salts 0·48		0·28	0·25	1·4	1·6	–	with salts		trace	,,	0·49	
–	–	–	–	–	?	1·26	?	0·09	0·92	81·3	0·80	1·50	1·28	1·12	3·6	3·4	–	–	trace	0·38	0·09	0·92	
–	–	–	–	–	?	0·16	?	0·16	0·04	82·6	0·60	1·10	0·69	1·55	4·5	3·7	–	Chl. 1·26		trace	0·16	0·04	
–	–	–	–	–	?	5·7	0·3	–	4·8	63·1	–	–	6·0	0·3	9·0	6·2	–	traces		0·19	–	4·8	–*b*
–	–	–	–	–	trace	–	–	–	–	78·1	1·08	0·73	0·57	0·43	5·75	6·24	–	–	–	trace	trace	–	
–	3·0	–	3·4	–	0·13	0·28	0·27	0·20	0·41	75·2	salts 0·62		0·28	0·27	0·80	8·45	–	with salts		0·03	3·6	0·41	–*c*
–	–	–	–	–	?	0·35	trace	0·26	0·13	83·4	salts trace		0·35	trace	2·6	3·0	–	trace		–	0·26	0·13	
–	–	–	–	–	?	0·81	trace	0·08	0·16	88·2	salts trace		0·81	trace	2·2	5·1	–	trace		–	0·08	0·16	
–	–	–	–	–	0·17	0·48	?	–	0·38	80·1	0·13	0·12	0·48	0·10	1·2	6·8	trace	–	trace	trace	–	0·38	–*d*

bination or Hydrate, and is not expelled by boiling heat. This remark refers to all the other Analyses where water is of Sulphate of Iron present in the soil.——*d.* Called a 'diaf' soil in Scotland, corrupted from 'dowf,' Anglicè 'inert.'

P 3, *continued*—SOILS (II.).

					General Division.										ENTIRE						
					Dried at 212° F.					Organic Matter.					Inorganic						
																		Soluble in			
																		Abundantly.			
	Species.	Locality.	Stones and Coarse Sand.	Fine Matter.	Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	No. of Analyses.	Nitrogen.	Ammonia.	Soluble Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.
Crops Failed, continued.	Turnips rotted 4 times in Autumn.	Pinkie, Edinburgh.	-	-	Johnston	1	?	5·7	93·3	— —	–	–	–	–	Johnston	1	–				
	Plantains would not grow.	Jamaica	-	-	Johnston	1	?	9·6	90·4	— —	–	–	–	–	Johnston	1	–				
	Plantation of fir trees dying.	Carclew.	-	-	Hunt	1	?	3·6	96·4	Hunt	1	–	–	2·00	Hunt	1	–	?	–	0·42	
	Do. 18 in. deep.	Carclew.	-	-	Hunt	1	?	1·5	98·5	Hunt	1	–	–	1·15	Hunt	1	–	?	–	0·75	
	Do. below	Carclew.	-	-	Hunt	1	?	2·3	97·7	Hunt	1	–	–	0·75	Hunt	1	–	?	–	0·47	
State of Lime in Soils.	Insol. Silicate, virgin soil	Caledonian Forest.	-	-	Johnston	1	?	5·3	94·7	— —	–	–	–	–	Johnston	1	–		salts 0·43		
	All the Lime in state of Sulphate.	Craigie, near Ayr.	-	-	Johnston	1	?	3·6	96·4	— —	–	–	–	–	Johnston	1	–		salts ?		
			-	-	Johnston	1	?	6·8	93·2	— —	–	–	–	–	Johnston	1	–		salts ?		
			-	-	Johnston	1	?	9·7	90·3	— —	–	–	–	–	Johnston	1	–		salts ?		
			-	-	Johnston	1	?	7·2	92·8	— —	–	–	–	–	Johnston	1	–		salts ?		
	Carbonate	Plain of Athens.	-	-	Johnston	1	?	5·8	94·2	— —	–	–	–	–	Johnston	1	–	?		salts 0·20	
Said to be overlimed.	Reclaimed Peat?	Ballindolloch, Banffshire.	-	-	Johnston	1	?	10·3	89·7	— —	–	–	–	–	Johnston	1	–				
			-	-	Johnston	1	?	9·5	90·5	— —	–	–	–	–	Johnston	1	–				
			-	-	Johnston	1	?	5·7	94·3	— —	–	–	–	–	Johnston	1	–				
Ochrey Soils, &c.	Soil	Shewalton	-	-	Johnston	1	?	21·7	78·3	Johnston	1		–	?	Johnston	1	–		salts 0·73		
	Moor Pan	Argyleshire	-	-	Johnston	1	1·4	2·7	95·9	Johnston	1		–	?	Johnston	1	–	–	–	–	–
			-	-	Johnston	1	1·6	24·5	73·9	Johnston	1	*h*	–	?	Johnston	1	–	–	–	–	–
			-	-	Johnston	1	1·5	3·2	95·3	Johnston	1		–	?	Johnston	1	–	–	–	–	–
	Bog Iron Ore.	Islay	-	-	Johnston	1	4·9	19·6	75·5	Johnston	1		–	19·6	Johnston	1	–	–	–	–	–

a. Dry Sulphate of Soda cured the sick Fir Trees. These Analyses well show the connection between the soil and subsoil.—— of Carbonate of Lime (Chalk) in the soil.——*d.* Too open to give good return in Oats and Clover.——*e.* Thick sand.——

P 3, *continued*—SOILS (II.).

COMPOSITION PER CENT.

Matter or Ash.

Rain Water.										Total Inorganic Matter.													
Abundantly.					Sparingly.																		
Magnesia.	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia.	Sulphuric Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
salts 1·07					?	0·17	trace	–	0·14	84·6	salts 1·07		0·17	trace	6·9		0·24	with salts		–	–	0·14	
salts 1·16					?	0·21	trace	–	0·17	84·3	salts 1·16		0·21	trace	1·2	3·2	0·07	with salts		–	–	0·17	
–	–	–	–	–	?	0·87	0·06	0·44	0·51	83·3	2·25	–	0·87	0·06	4·1	4·5	–	0·42		–	0·44	0·51	
–	–	–	–	–	?	1·18	0·12	0·74	0·66	76·5	3·0	–	1·31	0·17	10·1	5·1	–	0·75		0·22	0·74	0·66	–*a*
–	–	–	–	–	?	0·96	0·55	0·60	1·04	72·5	4·25	trace	0·96	0·55	12·8	5·7	–	0·47		–	0·60	1·04	
–	–	–	with salts	–	?	trace	0·24	trace	0·27	69·2	salts 0·43		4·15	0·24	13·2	5·8	–	with	salts	0·02	trace	0·27	–*b*
–	–	–	?	–	?	0·29	trace	0·41	trace	90·1	–	–	0·29	trace	1·13	3·52	0·19	–	–	0·08	0·41	trace	
–	–	–	?	–	?	0·20	trace	0·30	trace	87·3	–	–	0·20	trace	1·72	2·60	0·49	–	–	trace	0·30	trace	
–	–	–	?	–	?	0·26	trace	0·38	trace	86·1	–	–	0·26	trace	0·61	2·42	0·22	–	–	trace	0·38	trace	
–	–	–	?	–	?	0·54	trace	0·76	trace	84·0	–	–	0·54	trace	1·0	5·58	0·88	–	–	0·13	0·76	trace	
–	–	–	?	–	?	21·4	0·35	0·11	17·2	50·3	–	salts 0·20	21·4	0·35	2·35	2·91	–	–	with salts	0·016	0·11	17·2	–*c*
salts 0·45					?	0·80	trace	–	0·60	81·8	salts 0·45		0·80	trace	1·71	2·49	trace	with salts		–	with salts	0·60	
salts 0·15					?	0·39	trace	–	0·30	82·8	salts 0·15		0·39	trace	2·54	3·68	0·72	with salts		–	,,	0·30	–*d*
salts 0·50					?	0·62	trace	–	0·48	91·2	salts 0·50		0·62	trace	1·11	0·50	trace	with salts		–	,,	0·48	
–	?	–	with salts	?	0·06	0·19	0·16	0·04	0·29	29·2	salts 0·73		0·19	0·16	4·8	42·9	–	with salts		–	0·04	0·29	
–	?	–	–	–	?	–	–	–	–	85·9	–	–	–	–	1·7	8·6	–	–	–	–	–	–	–*e*
–	?	–	–	–	?	–	–	–	–	34·8	–	–	–	–	–	37·5	–	–	–	–	–	–	–*f*
–	?	–	–	–	?	–	–	–	–	83·9	–	–	–	–	2·0	9·7	–	–	–	–	–	–	–*g*
–	?	–	–	–	?	–	–	–	–	1·2	–	–	–	–	17·9	56·6	–	–	–	–	–	–	

b. Analysed in the ordinary way there was only a trace of Lime.——*c*. Mr. Hewett, Davis's Farm, Croydon, has 41 per cent.
f. Thin cups.——*g*. Granitic conglomerate.——*h*. All the Organic Matter in the form of Acid in combination with the Iron.

P 4.—SOILS (II.).

	Species.	Locality.	General Division. Dried at 212° Fahr. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Organic Matter. Ultimate Elements. Authority.	Number of Analyses.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Inorganic. Authority.	Number of Analyses.	Total Sulphur.	Soluble in Abundantly. Potash.	Soda.	Chloride of Potass.	Chloride of Sodium.
Clover.	Succeeded	Same field	Anderson	1	1500	2460	56040	Anderson	1	90	109	162	Anderson	1	–			trace	
	Failed		Anderson	1	1500	2460	56040	Anderson	1	90	109	186	Anderson	1	–				
	Succeeded	Same field	Anderson	1	1980	2040	55980	Anderson	1	126	152	402	Anderson	1	–				
	Failed		Anderson	1	1980	2580	55440	Anderson	1	126	152	522	Anderson	1	–				
Flax.	Good Irish.	Counties London-derry and Tyrone.	Sir R. Kane	1	?	3120	56880	Sir R. Kane	1	?	?	–	Sir R. Kane	1	–				
			Sir R. Kane	1	?	4500	55500	Sir R. Kane	1	?	?	–	Sir R. Kane	1	–				
			Sir R. Kane	1	?	6180	53820	Sir R. Kane	1	?	?	–	Sir R. Kane	1	–				
	Best Dutch.	Courtrai .	Hodges .	1	?	2820	57180	Hodges .	1	?	?	–	Hodges .	1	–				
		Lokeren .	Hodges .	1	?	1980	58020	Hodges .	1	?	?	–	Hodges .	1	–				
		Ypres . .	Hodges .	1	?	3600	56400	Hodges .	1	?	?	–	Hodges .	1	–				
Very Fertile.	Surface	Sutton, Norfolk.	Playfair .	1	1560	1440	57000	– –	–	–	–	–	Playfair .	1	–	?	?	–	trace
	Subsoil		Playfair .	1	1560	720	57720	– –	–	–	–	–	Playfair .	1	–	?	?	–	1248
	Alluvial	Horn-church, Essex.	Ure . .	1	1800	4440	53760	Ure . .	1	84	102	–	Ure . .	1	–	–	–	trace	
Crops Failed.	Barren Pasture.	Braydon, N. Wilts.	Way . .	1	?	4020	55980	– –	–	–	–	–	Way . .	1	–	?	?	–	–
	Peas rotted	Lancaster .	Völcker .	1	?	6000	54000	Völcker .	1	–	–	558	Völcker .	1	3792	salts 372			
	Barley failed.	Lynedock, Perthshire.	Johnston	1	?	6000	54000	– –	–	–	–	–	Johnston	1	–	salts trace			
	Ditto subsoil.		Johnston	1	?	1260	58740	– –	–	–	–	–	Johnston	1	–	salts trace			
	Oats rotted	Pampherston	Anderson	1	1440	4800	53760	Anderson	1	–	–	3426	Anderson	1	–	–	–	–	trace

P 4.—SOILS (II.).

PER STATUTE ACRE, IN CWTS.—1 FOOT DEEP.																						
Matter or Ash.																						
Rain-water.										Total Inorganic Matter.												
Abundantly.					Sparingly.																	
Magnesia	Iron.	Phos. Acid.	Sulph. Acid.	Carbonic Acid.	Silica.	Lime.	Magnesia	Sulph. Acid.	Carbonic Acid.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
salts 276					12	?	?	?	?	48780	132	54	798	150	1800	4008	–	trace		42	48	204
salts 264					48	?	?	?	?	50400	120	42	738	270	1440	2670	–	trace		228	30	54
salts 354					198	?	?	?	?	50160	318	78	420	138	1500	3108	–	–	–	156	90	trace
salts 282					trace	?	?	?	?	48600	330	trace	510	168	2340	3366	–	–	–	126	60	108
salts 192					?	360	with salts.	–	300	48000	salts 192		360	with salts.	4320	3600	–	with salts		18	with salts.	300
salts 156					?	186	?	?	144	47100	salts 156		186	,,	3900	3720	–	with salts		78	,,	144
salts 282					?	618	?	?	486	42600	salts 282		618	,,	5880	3780	–	with salts		90	,,	486
salts 120					?	360	60	–	360	54300	salts 120		360	60	900	1200	–	with salts		trace	,,	360
salts 84					?	186	trace	–	144	56160	salts 84		186	trace	720	720	–	with salts		trace	,,	144
salts 288					?	168	150	–	294	53400	salts 288		168	150	840	960	–	with salts		trace	,,	294
–	–	–	–	–	?	756	?	54	552	48780	480	900	768	672	2160	2040	–	–	trace	228	54	552
–	–	–	–	–	?	96	?	96	24	49560	360	660	414	930	2700	2220	–	Chl. 756		trace	96	24
–	–	–	–	–	?	3420	180	–	2880	37860	–	–	3600	180	5400	3720	–	trace		114	–	2880
–	–	–	–	–	trace	–	–	–	–	46860	648	438	342	258	3450	3744	–	–	–	trace	trace	–
–	1800	–	2040	–	78	168	162	120	246	45120	salts 372		168	162	480	5070	–	with salts		18	2160	246
–	–	–	–	–	?	210	trace	156	78	50040	salts trace		210	trace	1560	1800	–	trace		–	156	78
–	–	–	–	–	?	486	trace	48	96	52920	salts trace		486	trace	1320	3060	–	trace		–	48	96
–	–	–	–	–	102	288	?	–	228	48060	78	72	288	60	720	4080	trace	–	trace	trace	–	228

P 4, *continued*.—SOILS (II.).

			General Division.										ENTIRE COMPOSITION PER						
			Dried at 212° Fahr.					Organic Matter.					Inorganic						
								Ultimate Elements								Soluble in			
																Abundantly.			
	Species.	Locality.	Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	No. of Anal.	Nitrogen.	Ammonia.	Sol. Organic Matter.	Authority.	Number of Analyses.	Total Sulphur.	Potash.	Soda.	Chloride of Potass.	Chloride of Sod.
Crops failed—continued.	Turnips rotted in Autumn 4 years.	Pinkie, Edinburgh.	Johnston	1	?	4020	55980	– –	–	–	–	–	Johnston	1	–				
	Plantain would not grow.	Jamaica	Johnston	1	?	5760	54240	– –	–	–	–	–	Johnston	1	–				
	Plantation of Fir-trees dying.	Carclew .	Hunt . .	1	?	2160	57840	Hunt . .	1	–	–	1200	Hunt . .	1	–	?	–	252	
	Ditto 18 inches deep.	Carclew .	Hunt . .	1	?	900	59100	Hunt . .	1	–	–	690	Hunt . .	1	–	?	–	450	
	Ditto below ditto.	Carclew .	Hunt . .	1	?	1380	58620	Hunt . .	1	–	–	450	Hunt . .	1	–	?	–	282	
State of Lime in Soils.	Insoluble Silicate, virgin soil	Caledonian Forest.	Johnston	1	?	3180	56820	– –	–	–	–	–	Johnston	1	–		salts 258		
	Sulphate	Craigie, near Ayr	Johnston	1	?	2160	57840	– –	–	–	–	–	Johnston	1	–		salts ?		
			Johnston	1	?	4080	55920	– –	–	–	–	–	Johnston	1	–		salts ?		
			Johnston	1	?	5820	54180	– –	–	–	–	–	Johnston	1	–		salts ?		
			Johnston	1	?	4320	55680	– –	–	–	–	–	Johnston	1	–		salts ?		
	Carbonate.	Plain, Athens.	Johnston	1	?	3480	56520	– –	–	–	–	–	Johnston	1	–		salts 120		
Said to be Overlimed.	Reclaimed Peat?	Ballindalloch, Banffsh.	Johnston	1	?	6180	53820	– –	–	–	–	–	Johnston	1	–				
			Johnston	1	?	5700	54300	– –	–	–	–	–	Johnston	1	–				
			Johnston	1	?	3420	56580	– –	–	–	–	–	Johnston	1	–				
Ochrey Soils.	Soil . .	Shewalton	Johnston	1	?	13020	46980	Johnston	1		–	?	Johnston	1	–		salts 438		
	Moor Pan	Argyleshire.	Johnston	1	840	1620	57540	Johnston	1		–	?	Johnston	1	–	–	–	–	–
			Johnston	1	960	14700	44340	Johnston	1	*a*	–	?	Johnston	1	–	–	–	–	–
			Johnston	1	900	1920	57180	Johnston	1		–	?	Johnston	1	–	–	–	–	–
	Bog Iron Ore.	Islay . .	Johnston	1	2940	11760	45300	Johnston	1		–	11760	Johnston	1	–	–	–	–	–

a All the Organic Matter in the form of

P 4, *continued.*—SOILS (II.).

STATUTE ACRE IN CWTS.—1 FOOT DEEP.

Matter or Ash.

Rain Water. Abundantly. Magnesia	Iron.	Phos. Acid.	Sulphuric Acid.	Carbonic Acid.	Sparingly. Silica.	Lime.	Magnesia	Sulphuric Acid.	Carbonic Acid.	Total Inorganic Matter. Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
salts 642					?	102	trace	–	84	50760	salts 642		102	trace	4140		144	with salts		–	–	84
salts 696					?	126	trace	–	102	50580	salts 696		126	trace	720	1920	42	with salts		–	–	102
–	–	–	–	–	?	522	36	264	306	49980	1350	–	522	36	2460	2700	–	252		–	264	306
–	–	–	–	–	?	708	72	444	396	45900	1800	–	786	102	6060	3060	–	450		132	444	396
–	–	–	–	–	?	576	330	360	624	43500	2550	trace	576	330	7680	3420	–	282		–	360	624
–	–	–	with salts.	–	?	trace	144	trace	162	41520	salts 258		2490	144	7920	3480	–	with salts		12	trace	162
–	–	–	–	–	?	174	trace	246	trace	54060	?	?	174	trace	678	2112	114	?	?	48	246	trace
–	–	–	–	–	?	120	trace	180	trace	52380	?	?	120	trace	1032	1560	294	?	?	trace	180	trace
–	–	–	–	–	?	156	trace	228	trace	51660	?	?	156	trace	366	1452	132	?	?	trace	228	trace
–	–	–	–	–	?	324	trace	456	trace	50400	?	?	324	trace	600	3348	528	?	?	78	456	trace
–	–	–	with salts.	–	?	12840	210	66	10320	30180	salts 120		12840	210	1410	1746	–	–	with salts	10	66	10320
salts 270					?	480	trace	–	360	49080	salts 270		480	trace	1026	1494	trace	with salts		–	with salts	360
salts 90					?	234	trace	–	180	49680	salts 90		234	trace	1524	2208	432	with salts		–	,,	180
salts 300					?	372	trace	–	288	54720	salts 300		372	trace	666	300	trace	with salts		–	,,	288
–	?	–	with salts.	?	36	114	96	24	174	17520	salts 438		114	96	2880	25740	–	with salts		–	24	174
–	?	–	–	–	?	–	–	–	–	51540	–	–	–	–	1020	5160	–	–	–	–	–	–
–	?	–	–	–	?	–	–	–	–	20880	–	–	–	–	–	22500	–	–	–	–	–	–
–	?	–	–	–	?	–	–	–	–	50340	–	–	–	–	1200	5820	–	–	–	–	–	–
–	?	–	–	–	?	–	–	–	–	720	–	–	–	–	10740	33960	–	–	–	–	–	–

Acid in combination with the Iron.

Q 1.—ROTATION OF CROPS.

		Produce per Acre.		General Division.					ENTIRE COMPOSITION								
				In Natural State.					Organic or								
									Ultimate Elements.						Proximate		
																Azotized.	
Crops.	Parts.	Tons.	Cwt.	Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ammonia.	Authority.	Number of Anal.
Soluble Ingredients in soil . .				Richardson	1	?	?	34384	– –	–	–	–	–	–	–	– –	–
1 Turnips	Bulb .	30	–	Richardson	10	60480	6120	600	Richardson	10	2754	402	2889	75	91	Johnston .	5
	Tops .	5	–	Richardson	10	9790	1155	255	Richardson	10	560	78	482	35	42	– –	
2 Barley	Grain .	1	3	Thomson	1	333	2139	69	Thomson .	1	1016	147	932	41	50	Hermbstadt	
	Straw .	1	10	Sprengel	1	672	2512	176	Boussingault and Payen.	1	–	–	–	8	10	– –	–
3 Clover	1st Cut. Hay.	2	–	Way . .	2	586	3584	310	Boussingault	1	1838	192	1474	79	96	Johnston .	?
	After-math.	1	–	Way . .	2	293	1792	155	Boussingault	1	919	96	737	39	48	Johnston .	?
4 Wheat	Grain .	–	18	Way . .	62	233	1726	33	Boussingault	1	815	103	765	43	52	Gregory .	7
	Straw & Chaff.	1 –	10 3·5	Way . .	40	453	3109	200	Boussingault	1	1619	178	1300	13	16	Johnston .	?
Total Ingredients abstracted from soil and atmosphere.					–	72840	22137	1798	– –	–	–	–	–	333	–	– –	–
Ditto, restored to soil in manure					–	?	?	1696	– –	–	–	–	–	?	–	– –	–
Total loss to soil in 4 years					–	566	3865	102	– –	–	1831	250	1697	84	102	– –	–
Average yearly loss per acre					–	141	966	26	– –	–	458	62	424	21	25	– –	–
5 Cwt. Oilcake contains . . .				Way . .	7	42	482	35	Way . .	7	–	–	–	26	32	Fromberg .	1

a. There is a slight error in this table, which, although of no consequence in a hypothetical case, ought to be corrected per acre.——*b.* This first rotation is commonly called the Norfolk Four-Course, and is,

Q 1.—ROTATION OF CROPS.

PER STATUTE ACRE, IN POUNDS.

Combustible Matter.								Inorganic Matter or Ash.															
Elements.																							
Azotised.			Unazotised.																				
Albumen.	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk.	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.
–	–	–	–	–	–	–	–	Richardson	1	–	1680	4368	1008	11648	1120	–	–	–	Chl. 4816		–	9744	?
	–	–	132	–	921	3619	1251	Richardson	10	–	21	156	102	66	21	–	6	–	Chl. 33		75	75	48
-	–	–	–	–	–	–	–	Richardson	10	–	45	40	16	66	8	–	9	–	Chl. 22		10	25	14
–	130	–	5	1468	107	114	315	Liebig .	2	–	18	8	6	2	6	–	1	–	–	–	27	0·1	–
–	–	–	–	–	–	–	–	Sprengel.	1	–	130	6	2	18	3	5?	0·3	0·5	Chl. 2		5	4	–
	430		143		1855		1156	Way . .	2	18	10	51	7	110	34	–	3	–	Chl. 8		19	13	52
	215		71		927		578	Way . .	2	9	5	25	4	55	17	–	1	–	Chl. 4		10	6	26
61	201	–	–	1129	94		242	Way . .	28	–	1	11	1	1	4	–	0·2	–	–	–	15	0·1	–
	44		17		1031		1713	Way . .	2	–	137	32	4	12	4	–	1	–	–	–	6	5	–
	1278		368		11265		5255	– –	–	–	367	329	142	330	97	?	22	?	Chl. 69		167	128	140
–	?	–	?	–	?	–	?	– –	–	–	348	310	135	327	87	–	21	–	–	69	125	128	140
	392		5		2912		557	– –	–	–	19	19	7	3	10	–	1	–	–	–	42	0·2	–
	98		1		728		139	– –	–	–	5	5	2	1	2·5	–	0·2	–	–	–	10	–	–
	124		70	–	203	–	71	Way . .	2	–	4	8	0·7	3	5	–	1	–	–	0·5	10	1	?

when calculating for practical purposes, and that is, the seed corn has been omitted to be subtracted from the total produce particularly adapted for all lands that are light enough for the turnips to be fed off with sheep.

Q 1, *continued.*—ROTATION OF CROPS.

	Crops.	Parts.	Produce per Acre. Tons.	Produce per Acre. Cwt.	General Division. In Natural State. Authority.	Number of Analyses.	Water.	Organic Matter.	Ash.	ENTIRE COMPOSITION. Ultimate Elements. Authority.	Number of Analyses.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Organic or Proximate. Ammonia.	Azotized. Authority.	Number of Anal.
Soluble Ingredients in soil . .					Richardson	1	?	?	34384	— —	–	–	–	–	–	–	— —	–
1	Turnip	Bulb .	30	–	Richardson	10	60480	6120	600	Richardson	10	2754	402	2889	75	91	Johnston .	5
		Tops .	5	–	Richardson	10	9790	1155	255	Richardson	10	560	78	482	35	42	— —	–
2	Wheat	Grain .	–	18	Way . .	62	233	1726	33	Boussingault	1	815	103	765	43	52	Gregory .	7
		Straw & Chaff.	1 –	10 3·5	Way . .	40	453	3109	200	Boussingault	1	1619	178	1300	13	16	Johnston .	?
3	Beans	Grain .	–	19	Way . .	6	304	1720	56	Playfair .	1	805	121	690	104	126	Boussingault	1
		Straw .	1	4	Way . .	4	267	2282	151	Boussingault	1	1169	127	907	60	73	— —	–
4	Wheat	Grain .	–	18	Way . .	62	233	1726	33	Boussingault	1	815	103	765	43	52	Gregory .	7
		Straw & Chaff.	1 –	10 3·5	Way . .	40	453	3109	200	Boussingault	1	1619	178	1300	13	16	Johnston .	?
5	Man-golds	Bulbs .	25	–	Way . .	3	50800	4700	500	Boussingault	1	2142	289	2183	86	104	Cameron .	3
		Top .	5	–	Way . .	3	10080	930	190	Boussingault	1	448	63	366	53	64	— —	–
6	Wheat	Grain .	–	18	Way . .	62	233	1726	33	Boussingault	1	815	103	765	43	52	Gregory .	7
		Straw & Chaff.	1 –	10 3·5	Way . .	40	453	3109	200	Boussingault	1	1619	178	1300	13	16	Johnston .	?
7	Clover	1st Cutting Hay	2	–	Way . .	2	586	3584	310	Boussingault	1	1838	192	1474	79	96	Johnston .	?
		Aftermath	1	–	Way . .	2	293	1792	155	Boussingault	1	919	96	737	39	48	Johnston .	?
8	Wheat	Grain .	–	18	Way . .	62	233	1726	33	Boussingault	1	815	103	765	43	52	Gregory .	7
		Straw & Chaff.	1 –	10 3·5	Way . .	40	453	3109	200	Boussingault	1	1619	178	1300	13	16	Johnston .	?
Total Ingredients abstracted from soil and atmosphere.						–	135,344	41623	3149	— —	–	20371	2492	17988	755	913	— —	–
Ditto, restored to soil in manure						–	?	?	2961	— —	–	?	?	?	?	?	— —	–
Total loss to soil in 8 years						–	1236	8624	188	— —	–	4065	533	3750	276	334	— —	–
Average yearly loss per acre						–	154	1078	24	— —	–	508	67	469	35	42	— —	–
5 Cwt. Oilcake contains . .					Way . .	7	42	482	35	Way . .	7	–	–	–	26	32	Fromberg .	1

a. I have inserted the *organic* analyses of Pea-straw, as I know not of any *organic* analyses of Bean-straw.——*b.* This rotation is tenant.——*c.* I would not advise much reliance to be placed on the proximate analyses of these crops.——*d.* In these rotations

Q 1, *continued.*—ROTATION OF CROPS.

PER STATUTE ACRE, IN POUNDS.																								
Combustible Matter.								Inorganic Matter or Ash.																
Elements.																								
Azotised.			Unazotised.																					
Albumen	Gluten.	Casein.	Fat, Oil.	Starch.	Gum, Dextrine, Pectine.	Sugar.	Fibre and Husk	Authority.	Number of Analyses.	Total Sulphur.	Sand and Silica.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Chloride of Potassium.	Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	
–	–	–	–	–	–	–	–	Richardson	1	–	1680	4368	1008	11648	1120	–	–	–	Chl. 4816		–	9744	–	
197	–	–	132	–	921	3619	1251	Richardson	10	–	21	156	102	66	21	–	6	–	Chl. 33		75	75	48	
–	–	–	–	–	–	–	–	Richardson	10	–	45	40	16	66	8	–	9	–	Chl. 22		10	25	14	
61	201	–	–	1129	94		242	Way . .	28	–	1	11	1	1	4	–	0·2	–	–	–	15	0·1	–	
	44		17		1031		1713	Way . .	2	–	137	32	4	12	4	–	1	–	–	–	6	5	–	
	559		42	782	89	42	206	Way . .	6	5	0·4	23	0·4	5	4	–	0·2	–	Chl. 1		18	3	1	
–	–	–	–	–	–	–	–	Way . .	4	7	6	32	12	32	7	–	1	–	Chl. 8		11	5	35	a
61	201	–	–	1129	94		242	Way . .	28	–	1	11	1	1	4	–	0·2	–	–	–	15	0·1	–	
	44		17		1031		1713	Way . .	2	–	137	32	4	12	4	–	1	–	–	–	6	5	–	
55	–	112	–	–	112	3472	952	Way . .	3	–	10	123	126	10	10	–	5	–	Chl. 87		18	18	90	
–	–	–	–	–	–	–	–	Way . .	3	–	3	40	39	17	17	–	2	–	Chl. 39		10	11	12	
61	201	–	–	1129	94		242	Way . .	28	–	1	11	1	1	4	–	0·2	–	–	–	15	0·1	–	b
	44		17		1031		1713	Way . .	2	–	137	32	4	12	4	–	1	–	–	–	6	5	–	
	430		143		1855		1156	Way . .	2	18	10	51	7	110	34	–	3	–	Chl. 8		19	13	52	
	215		71		927		578	Way . .	2	9	5	25	4	55	17	–	1	–	Chl. 4		10	6	26	
61	201	–	–	1129	94		242	{Way . .	28	–	1	11	1	1	4	–	0·2	–	–	–	15	0·1	–	
	44		17		1031		1713	Way . .	2	–	137	32	4	12	4	–	1	–	–	–	6	5	–	
	2792		456		20835		11963	– –	–	–	653	662	327	413	150	–	32	–	Chl. 202		255	176	278	c
–	?	–	?	–	?	–	?	– –	–	–	648	595	322	404	130	–	31	–	Chl. 201		177	172	277	
	1607		42		5805		1174	– –	–	–	5	67	5	9	20	–	1	–	Chl. 1		78	4	1	
	201		5		726		147	– –	–	–	0·6	9	0·6	1	3	–	0·1	–	Chl. 0·1		10	0·5	0·1	d
	124		70	–	203	–	71	Way . .	2	–	4	8	0·7	3	5	–	1	–	1		10	1	1	

the one carried out on the late Model Farm of Earl Ducie's, Whitfield Berkeley, Gloucestershire, by Mr. Morton, the present
I suppose that the grain only is sold off the farm, the rest being fed on the farm, and also that no artificial manure is bought.

XXIII.—*Some Account of the Cultivation of a Farm in Silesia by Artificial Manure alone for fourteen years.* By Mr. Rötschke.

[The following letter has just been written in answer to inquiries from Mr. Thaer, son of the great agricultural writer, whose grandson having obligingly placed it in my hands, I thought it worth translation, not, of course, from the slightest idea of recommending such a system in England, but because the system therein described appears to throw some light on the scientific question whether it is necessary upon all soils to supply carbonaceous matter as food for plants.—Ph. Pusey.]

To Mr. Thaer, Director of the Royal Agricultural School at Moeglin.

Sir,—In compliance with your request I beg to inform you that my farm at Wohla, in the north-west part of Silesia, distant nine miles from Bautzen and two miles from Löbau, consists of 546 Prussian morgen, of which 410 are arable, 45 meadow, and the rest woodland, with a southern exposure, the soil a free loam, the subsoil granitic. It has been in my family for 100 years. Notwithstanding its good soil and favourable situation, the income arising from it was very moderate under the original management in which three crops of rye were taken successively. Nor was it much more profitable when the three years course was substituted, namely, two white crops and a naked fallow. Hence arose a state of embarrassment which obliged me to look about for new resources. After many anxious consultations with my then neighbour, Baron A. von Gablentz, we were convinced that very great profits would accrue if the whole produce were yearly sold off without passing through the intestines of stock kept on the farm. The question arose how to supply the place of the dung, a very difficult one, since at that time hardly any artificial manure was used in Lusatia, and none in Wohla, except lime, gypsum, and horn-parings. It was evident that neither lime nor gypsum would answer, while horn-parings were both scarce and dear. Rapecake, however, was abundant and cheap, costing only 30*s.* per ton, and in this I determined to trust.

Every one denounced the project, saying that in three years the soil would be exhausted. Nor was I myself without dread, that the ground, missing the mechanical separation produced by the dung, would close its pores, and losing the influence of the atmosphere become unfruitful. This fear, however, was groundless, for my teams being at liberty from dung-cart were able to till the land at all times, and more thoroughly, while the artificial manure produced increased crops that shaded the land better in summer, keeping it porous.

I retained a rotation which I had just introduced, and which had been as follows:—1. Wheat or rye dunged; 2. Potatoes; 3. Barley; 4. Clover mowed; 5. Rye dunged; 6. Oats, partly with white clover; 7. Clover ploughed early, peas and flax. But instead of the dung I applied to the ploughed land $6\frac{2}{3}$ cwt., and to the grass land 8 cwt. of rapecake per morgen.* The yield was most satisfactory. I now, therefore, sold everything—corn, hay, potatoes, straw, green clover, for which last I sometimes obtained 4*l.* 10*s.* per morgen, parted with most of my teams every winter to save their keep, and realized more than double my previous income.

I was not, however, satisfied with the rapecake, as its action, which is strong in the first year, abates much in the next; and when its price doubled, rising to 3*l.* per ton, I abandoned it for bone-dust, taking care that the bones had passed through the hands neither of the soap-boiler nor the glue-maker, and applying 7 cwt. to the morgen. The bone-dust stood me in from 4*l.* 10*s.* to 6*l.* per ton, and though it acted less rapidly, was more lasting. On the whole, I prefer bone-dust for winter, and rapecake for spring crops. Latterly, I preferred Peruvian guano to either, to rapecake especially.

I thus farmed Wohla for *fourteen* years without dung, except what was produced by two cows kept for others, and by the teams in the summer half year. The system continued to pay me thoroughly. I do not at all contest the superiority of farmyard dung, but simply state that in such a country as this, without demand for fresh meat, but with a suitable soil, facility for obtaining manure, and facility for selling the produce, my own system pays decidedly best.

Being now more engaged in the Grand Duchy of Posen, I have just let my farm at a good rent, 10*s.* 6*d.* per morgen. The tenant continues very much the same system, keeping the teams on his adjoining farm, having no stock on Wohla but some sheep for feeding the grass-land, and paying his chief attention to the growth of rapeseed and of potatoes, from which last he distils spirits at his own residence.

Yours obediently, Rötschke.

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* A morgen is about two-thirds of an English acre.

Royal Agricultural Society of England.

1852—1853.

President.

LORD ASHBURTON.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Saturday, May 22, 1852.

REPORT OF THE COUNCIL.

Since the last General Meeting in December, 37 Members have died, and the names of 120 been removed from the list; while 104 Candidates have during the same period been elected: so that the Society now consists of—

93 Life Governors,
156 Annual Governors,
711 Life Members,
4002 Annual Members, and
19 Honorary Members;

making a total of 4981 Members on the list of the Society at the present time: a census which shows a slight decrease, since the last General Meeting, in the Governors and Members paying annual subscriptions, but an increase in those who have connected themselves more permanently with the Society by payment of the compositions for life.—The Council have appointed Mr. Miles, M.P., of Leigh Court, one of the Vice-Presidents of the Society, in the place of Sir Thomas Gooch, Bart., deceased; and have elected the Earl of March a general Member of the Council, to supply the vacancy thus created in that list, by the transfer of Mr. Miles's name to the list of the Vice-Presidents.

The Council have the satisfaction of stating, that at no former period in the history of the Society, have its finances been in a more favourable condition than at the present time.

The arrangements for the Country Meeting at Lewes, in the middle of July next, are nearly completed. The entries of Implements for exhibition and trial at this Meeting exceed in amount those made for any former occasion; and the entries of Live Stock, although not yet closed, promise to be equally numerous. The Council have adopted this year new regulations for the nomination and selection of the Judges of Stock; and they have limited the duties of the Veterinary Inspector to a general examination of the animals in reference to contagious or infectious disease, and to such special investigation on doubtful points, as the Judges in considering their awards may think proper to direct his attention. They have concluded their arrangements in the show-yard at Lewes for such an exhibition of Poultry as may, in their opinion, best promote competition among those varieties of breed which have been found by experience to be most profitable in an agricultural point of view; and for the purpose of enabling cottagers to compete for the Prizes in this department, the Council have reduced the non-Members' exhibition-fee from ten shillings to half-a-crown. The Council have accepted the invitation of the authorities of Gloucester to hold the Country Meeting of next year for the South-Wales District, in that city.

The Chemical Investigations instituted by the Society are in a state of active and favourable progress in the laboratory of Professor Way, the Consulting Chemist to the Society; who has already this season delivered before the Members two interesting Lectures on the peculiar agency of certain soils in promoting the supply of manuring matter as food to plants, and on the light thrown by the agricultural principles established more than a century ago by the celebrated Jethro Tull, on practical results obtained at the present day under certain conditions of soil and culture. Mr. Trimmer, the author of the Society's Prize Essay on Agricultural Geology, has also favoured the Members with a Lecture on the Geological Distribution of Soils throughout the Country; a subject of much practical importance to the Farmer who is desirous at any time of transferring analogically the system of one district to another locality identical with it in the circumstance of soil: a

result not always to be inferred from the ordinary geological maps, in which the rocks or subsoils are represented in their denuded state, and irrespectively of the actual drift or soil that may happen, from various causes, to rest upon their strata.

The Council are aware of the great caution required in the application of science to the practice of Agriculture; and of the guarded manner in which any new or striking facts of cultivation ought to be enunciated, in order that the particular circumstances of their occurrence may be most clearly defined. These circumstances they conceive must be accurately understood by the Farmer before he can safely transfer to his own locality a mode of management that may have been adopted with success elsewhere. Science, so called, can only mislead, when its quality is unsound, or its application erroneous: sound science, indeed, consisting only of principles derived immediately from facts; which principles, when duly applied to practice, constitute an art of any kind; and this art, whether that of agriculture or any other branch of industry, is only to be perfected by the application of improved principles, whether these be accidentally discovered or ascertained by direct investigation. The Council feel how much the modification or establishment of such principles of improvement depends on the extended practical observation and actual test of their Members; and while they are most desirous, on the one hand, to aid in their legitimate development, they are most anxious, on the other, to prevent their hasty adoption. The really best practice in Agriculture always includes as its prime mover the best science; but it is only by obtaining the distinct knowledge of such included science that the conditions can be ascertained under which the practice itself may be transferred successfully to other circumstances: and the Council, in endeavouring to carry out that union of "practice with science," which has become the well-known motto of the Society, invite from its Members such communications of successful instances of management or cultivation, as will either at once become models for adoption, or serve, by comparison with other results, to modify the character and extent of the deductions to be drawn

from them. With such practical aid, the Council feel assured that the Society will continue to proceed in its steady course of public usefulness, gradually developing those national objects for which it was originally established.

By order of the Council,

(Signed) JAMES HUDSON,
Secretary.

SUBSTITUTE FOR GUANO.

A Thousand Pounds and the Gold Medal of the Society will be given for the discovery of a Manure equal in fertilising properties to the Peruvian Guano, and of which an unlimited supply can be furnished to the English Farmer at a rate not exceeding *5l.* per ton.—A Committee has been appointed by the Council for deciding on the conditions under which the competition for this prize shall take place.

DISCOVERY OF GUANO.

Fifty Sovereigns will be given for the best Account of the Geographical Distribution of Guano; with suggestions for the discovery of any new source of supply, accompanied by specimens. The Essays competing for *this* Prize are to be sent to the Secretary, at the House of the Society, No. 12, Hanover Square, London, on or before March 1, 1854.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Half-yearly Account, ending the 31st of December, 1851.

Receipts.

	£.	s.	d.
Balance in the hands of the Bankers, 1st July, 1851	2584	9	5
Balance in the hands of the Secretary, 1st July, 1851	0	1	2
Dividends on Stock	160	6	1
Life-Compositions of Members	179	0	0
Annual Subscriptions of Governors	144	0	0
Annual Subscriptions of Members	1570	5	0
Receipts on account of Journal	201	0	3
Receipts on account of Country Meetings	3144	10	3
	£7983	12	2

(Signed) THOMAS RAYMOND BARKER, *Chairman,*
C. B. CHALLONER,
HENRY BLANSHARD,
} *Finance Committee.*

Payments.

	£.	s.	d.
Purchase of £1029 Stock in the $3\frac{1}{4}$ per cents.	1010	0	0
Permanent Charges	178	12	6
Taxes and Rates	13	19	5
Establishment	422	16	9
Postage and Carriage	19	11	0
Advertisements	2	16	6
Payments on account of Journal	303	3	2
Chemical Grant: two quarters	100	0	0
Chemical Investigations	200	0	0
Prizes of the Society	1820	0	0
Payments on account of the Country Meetings	2850	4	2
Transfer of Subscriptions	7	0	0
Sundry Items of Petty Cash	5	5	10
Balance in the hands of the Bankers, 31st December, 1851	1020	8	11
Balance in the hands of the Secretary, 31st December, 1851	29	13	11
	£7983	12	2

Examined, audited, and found correct, this 21st day of May, 1852.

(Signed) THOMAS KNIGHT,
GEO. I. RAYMOND BARKER,
GEORGE DYER,
} *Auditors on the part of the Society.*

SPECIAL COUNTRY MEETING ACCOUNT: WINDSOR, 1851.

Note.—The sum of £1870 as the amount of PRIZES awarded by the Society in the year 1851, is not included in this Special Account as an expense attending the Windsor Meeting, but is made chargeable in the General Account as a payment out of the common Funds of the Society.

RECEIPTS.	£.	s.	d.	PAYMENTS.	£.	s.	d.
Subscription from Windsor	600	0	0	Pavilion	840	0	0
Pavilion Dinner Tickets	957	10	0	Contract for Pavilion Dinner	850	0	0
Show-yard Receipts	3397	4	9	Expenses connected with Pavilion Dinner	93	3	3
Sale of Catalogues	497	15	1	Show-yard: erection and expenses	2264	13	2
Sala of Council Badges	6	10	0	London Police	113	0	0
Non-Members' Fees for Exhibition	116	10	0	Judges	225	17	6
Fines for non-Exhibition of Stock entered	32	10	0	Veterinary Inspector	10	0	0
				Printing, Paper, and Stitching of Catalogues and Awards	266	19	0
				Printing for the general purposes of the Meeting	83	8	0
				Stationery	19	5	1
				Advertisements	168	1	3
				Postage, Carriage, and Travelling Expenses	51	14	3
				Official Staff Charges	8	8	0
				Badges for the Council and Stewards	3	3	6
				Erection and fitting of temporary Offices	29	18	6
				Light Gold	0	7	0
				Legal Expenses connected with Recovery of Fines	3	15	0
				Balance carried to the credit of the General Funds of the Society	576	6	4
	£5607	19	10		£5607	19	10

Country Meeting at Lewes.

JULY 13—16, 1852.

JUDGES.

Short Horns.	William Smith	West Rasen, Lincolnshire.
	John Grey	Dilston, Northumberland.
	Thomas Short	Bawtry, Nottinghamshire.
Herefords and Mixed Breeds.	Henry Chamberlain	Desford, Leicestershire.
	Henry Trethewy	Grampound, Cornwall.
	John Edwin Jones	Branton, Herefordshire.
Devons.	Thomas Hartshorne	Brancote, Staffordshire.
	Thomas Townsend	Hillmorton, Warwickshire.
	Edward Pope	Great Toller, Dorsetshire.
Sussex Breed.	Edward L. Franklin	Ascott, Oxfordshire.
	William Cox	Scotsgrove, Buckinghamshire.
	John Williams	Kingsland, Herefordshire.
Horses.	William Greaves	Matlock-Bath, Derbyshire.
	Wm. Floyd Karkeek	Truro, Cornwall.
	Thomas Capon	Dennington, Suffolk.
Leicester Sheep.	Nathaniel C. Stone	Rowley Fields, Leicestershire.
	William Bartholomew	Goltho, Lincolnshire.
	William Tindall	Wheatley, Yorkshire.
South-Down Sheep.	Peter Purves	Brampton Grove, Huntingdonshire.
	Henry Fookes	Whitechurch, Dorsetshire.
	Henry P. Hart	Beddingham, Sussex.
Long-Woolled and Romney Marsh Sheep.	Hugh Aylmer	West Dereham, Norfolk.
	Percival Richardson	Horkstow, Lincolnshire.
	John Abbott	Ospringe, Kent.
Pigs.	William Hesseltine	Worlaby, Lincolnshire.
	John Clayden	Littlebury, Essex.
	John Clarke	Long Sutton, Lincolnshire.
Poultry.	Hon. & Rev. S. W. Lawley	Escrick, Yorkshire.
	T. B. Wright	Great Barr, Staffordshire.
	John Baily	Mount Street, London.
Implements.	William Owen	Rotherham, Yorkshire.
	Charles John Carr	Belper, Derbyshire.
	Owen Wallis	Overstone Grange, Northamptonshire.
	T. P. Outhwaite	Bainesse, Yorkshire.
	Thomas Scott	Broom Close, Yorkshire.
	Robert Beman	Moreton, Gloucestershire.
	William Shaw	Far Cotton, Northamptonshire.
	Thomas Hawkins	Assington Moor, Suffolk.
	James Hale Nalder	Alvescot, Gloucestershire.
	William Lister	Dunsa Banks, Yorkshire.

VETERINARY INSPECTOR,

AND REFEREE TO THE JUDGES OF LIVE STOCK.

Professor Simonds..........Royal Veterinary College, London.

CONSULTING ENGINEER,

AND REFEREE TO THE JUDGES OF IMPLEMENTS.

Charles Edwards Amos......The Grove, Southwark, Surrey.

AWARD OF PRIZES.

Cattle: *Short-Horns.*

Thomas Chrisp, of Hawkhill, near Alnwick, Northumberland: the Prize of Forty Sovereigns, for his 4 years and 4 months-old Short-horned Bull; bred by himself.

F. H. Fawkes, of Farnley, near Otley, Yorkshire: the Prize of Twenty Sovereigns, for his 3 years and 5 months-old Pure Short-horned Bull; bred by himself.

John Booth, of Killerby, near Catterick, Yorkshire: the Prize of Twenty-Five Sovereigns, for his 2 years and 1 month-old Short-horned Bull; bred by himself.

John Kirkham, of Hagnaby, near Spilsby, Lincolnshire: the Prize of Fifteen Sovereigns, for his 2 years and 2 months-old Pure Short-horned Bull; bred by himself.

Charles Towneley, of Towneley Park, near Burnley, Lancashire: the Prize of Twenty Sovereigns, for his 3 years and 2 months-old Pure Short-horned In-milk and In-calf Cow; bred by himself.

Charles Towneley, of Towneley Park, near Burnley, Lancashire: the Prize of Ten Sovereigns, for his 4 years and 4 months-old Pure Short-horned In-milk Cow; bred by Alexander Bannerman, of South Cottage, Chorley, Lancashire.

Richard Booth, of Warlaby, near Northallerton, Yorkshire: the Prize of Fifteen Sovereigns, for his 2 years and 5 months-old Short-horned In-calf Heifer; bred by himself.

Charles Towneley, of Towneley Park, near Burnley, Lancashire: the Prize of Ten Sovereigns, for his 2 years and 10 months-old Pure Short-horned In-milk and In-calf Heifer; bred by Mr. Turner, in Ireland.

Charles Towneley, of Towneley Park, near Burnley, Lancashire: the Prize of Ten Sovereigns, for his 1 year and 6 months-old Pure Short-horned yearling Heifer; bred by himself.

Richard Booth, of Warlaby, near Northallerton, Yorkshire: the Prize of Five Sovereigns, for his 1 year and 5 months-old Short-horned yearling Heifer; bred by himself.

Cattle: *Herefords.*

Edward Price, of the Courthouse, near Pembridge, Herefordshire: the Prize of Forty Sovereigns, for his 4 years and 5 months-old Hereford Bull; bred by himself.

The Earl of Radnor, of Coleshill, near Farringdon, Berkshire: the Prize of Twenty Sovereigns, for his 3 years and 4 months-old Hereford Bull, bred by himself.

George Brown, of Avebury, near Marlborough, Wiltshire: the Prize of Twenty-five Sovereigns, for his 1 year and 6 months-old Hereford Bull; bred by John Yeomans, of Stretton Court, near Hereford.

Lord Berwick, of Cronkhill, near Shrewsbury, Shropshire: the Prize of Fifteen Sovereigns, for his 2 years 6 months and 3 days-old Hereford Bull; bred by himself.

Lord Berwick, of Cronkhill, near Shrewsbury, Shropshire: the Prize of Twenty Sovereigns, for his 3 years 7 months and 15 days-old Hereford In-milk and In-calf Cow; bred by himself.

Philip Turner, of The Leen, near Leominster, Herefordshire: the Prize of Ten Sovereigns, for his 3 years 9 months and 15 days-old Hereford In-milk and In-calf Cow; bred by himself.

Lord Berwick, of Cronkhill, near Shrewsbury, Shropshire: the Prize of Fifteen Sovereigns, for his 2 years 7 months and 17 days-old Hereford In-calf Heifer; bred by himself.

Lord Berwick, of Cronkhill, near Shrewsbury, Shropshire: the Prize of Ten Sovereigns, for his 2 years 8 months and 24 days-old Hereford In-calf Heifer; bred by himself.

Walter Maybery, of Penlan, near Brecon, S.W.: the Prize of Ten Sovereigns, for his 1 year and 9 months-old Hereford yearling Heifer; bred by himself.

Lord Berwick, of Cronkhill, near Shrewsbury, Shropshire: the Prize of Five Sovereigns, for his 1 year 6 months and 19 days-old Hereford yearling Heifer; bred by himself.

Cattle: *Devons.*

Samuel Farthing, of Stowey Court, near Bridgewater, Somersetshire: the Prize of Forty Sovereigns, for his 3 years and 6 months-old Pure Devon Bull; bred by himself.

Thomas Bushby Morle, of Cannington Park, near Bridgewater, Somersetshire: the Prize of Twenty Sovereigns, for his 3 years 6 months and 15 days-old Pure Devon Bull; bred by John Quartly, of Molland, Devonshire.

James Hole, of Knowle House, near Dunster, Somersetshire: the Prize of Twenty-five Sovereigns, for his 1 year and 9 months-old Pure Devon Bull; bred by himself.

The Earl of Leicester, of Holkham, near Wells, Norfolk: the Prize of Fifteen Sovereigns, for his 2 years and 6 months-old North Devon Bull; bred by himself.

Samuel Farthing, of Stowey Court, near Bridgewater, Somersetshire: the Prize of Twenty Sovereigns, for his 3 years and 4 months-old Pure Devon Cow; bred by himself.

James Quartly, of Molland, near South Molton, Devonshire: the Prize of Ten Sovereigns, for his 10 years and 6 months-old pure North Devon Cow; bred by himself.

Samuel Farthing, of Stowey Court, near Bridgewater, Somerset: the Prize of Fifteen Sovereigns, for his 2 years and 3 months-old pure Devon In-calf Heifer; bred by himself.

James Quartly, of Molland, near South Molton, Devonshire: the Prize of Ten Sovereigns, for his 2 years and 6 months-old pure North Devon In-calf Heifer; bred by himself.

George Turner, of Barton, near Exeter, Devonshire: the Prize of Ten Sovereigns, for his 1 year and 8 months-old North Devon yearling Heifer; bred by himself.

William Baker, of Bishop's Nympton, near South Molton, Devonshire: the Prize of Five Sovereigns, for his 1 year and 7 months-old North Devon yearling Heifer; bred by himself.

Cattle: *Sussex.*

Arnold Denman, of Stoneham, Malling, near Lewes, Sussex: the Prize of Twenty Sovereigns, for his 3 years and 5 months-old Sussex Bull; bred by himself.

William Botting, of Westmeston, near Hurstperpoint, Sussex: the Prize of Ten Sovereigns, for his 4 years and 6 months-old Sussex Bull; bred by himself.

Josiah Pitcher, of Westham, near Eastbourne, Sussex: the Prize of Ten Sovereigns, for his 1 year and 6 months-old pure Sussex Bull; bred by himself.

Arthur and Thomas Barton, of Bexhill, near Battle, Sussex: the Prize of Ten Sovereigns, for their 6 years and 4 months-old Sussex In-milk and In-calf Cow; bred by themselves.

Henry Catt, of West Firle, near Lewes, Sussex; the Prize of Five Sovereigns, for his 6 years and 4 months-old Sussex In-calf Cow; bred by himself.

Arnold Denman, of Stoneham, Malling, near Lewes, Sussex: the Prize of Ten Sovereigns, for his 2 years and 5 months-old Sussex In-calf Heifer; bred by himself.

James Gorringe, of Selmeston, near Lewes, Sussex: the Prize of Five Sovereigns, for his 1 year and 8 months-old pure Sussex yearling Heifer; bred by himself.

Cattle: *Other Breeds* (not qualified to compete as Short-horns, Herefords, Devons, or Sussex).

Capt. William Inge, of Thorpe Constantine, near Tamworth, Staffordshire: the Prize of Ten Sovereigns, for his 4 years and 5 months-old Long-horned Bull; bred by John Baker, of Rollright, Oxfordshire.

John Gregory Watkins, of Woodfield, near Droitwich, Worcestershire: the Prize of Ten Sovereigns, for his 1 year and 4 months-old Channel Islands Bull; bred by himself.

Capt. William Inge, of Thorpe Constantine, near Tamworth, Staffordshire: the Prize of Ten Sovereigns, for his 7 years and 2 months-old Long-horned Cow; bred by himself.

William Tod, of Elphinstone Tower, near Tranent, Haddingtonshire: the Prize of Five Sovereigns, for his 2 years and 11 months-old West Highland In-calf Heifer; bred by John M'Donald, of Inverness.

[No entry was made for the Prize of Five Sovereigns offered by the Society for the best Yearling Heifer.]

Horses.

William Stearn, of Elmsett Hall, near Hadleigh, Suffolk: the Prize of Thirty Sovereigns, for his 3 years-old pure Suffolk Agricultural Stallion, bred by John Arthey, of Lindsey, Suffolk.

Samuel Clayden, of Linton, Cambridgeshire: the Prize of Fifteen Sovereigns, for his 3 years-old Suffolk Agricultural Stallion; bred by himself.

Thomas Catlin, of Butley, near Woodbridge, Suffolk: the Prize of Twenty Sovereigns, for his 2 years-old pure Suffolk Agricultural Stallion; bred by himself.

William Wilson, of Ashbocking, near Ipswich, Suffolk: the Prize of Ten Sovereigns, for his 2 years-old Suffolk Agricultural Stallion; bred by James Garnham, of Earl Stonham, Suffolk.

John Baxter, of Wiggenhall St. Peter's, near Lynn, Norfolk: the Prize of Fifteen Sovereigns, for his 4 years-old Roadster Stallion; bred by himself.

Nathaniel George Barthropp, of Cretingham Rookery, near Woodbridge, Suffolk: the Prize of Twenty Sovereigns, for his Suffolk Agricultural Mare and Foal; the Mare bred by R. Sease, of Laxfield; the sire of the Foal belonged to himself.

Frederick Barlow, of Hasketon, near Woodbridge, Suffolk: the Prize of Ten Sovereigns, for his Suffolk Agricultural Mare and Foal; the Mare bred by John Garnham, of Henley, Suffolk; the sire of the Foal belonged to Henry Wilson, of Ashbocking, Suffolk.

Samuel Wrinch, of Great Holland, near Colchester, Essex: the Prize of Fifteen Sovereigns, for his 2 years-old Suffolk Filly; bred by the Hon. and Rev. F. de Grey, of Copdock Rectory, Suffolk.

Samuel Wrinch, of Great Holland, near Colchester, Essex: the Prize of Five Sovereigns, for his 2 years-old Suffolk Filly; bred by himself.

Sheep: *Leicesters.*

William Sanday, of Holme Pierrepont, near Nottingham: the Prize of Thirty Sovereigns, for his 16 months-old Leicester Shearling Ram; bred by himself.

William Sanday, of Holme Pierrepont, near Nottingham: the Prize of Fifteen Sovereigns, for his 16 months-old Leicester Shearling Ram; bred by himself.

William Sanday, of Holme Pierrepont, near Nottingham: the Prize of Thirty Sovereigns, for his 40 months-old Leicester Ram; bred by himself.

William Sanday, of Holme Pierrepont, near Nottingham: the Prize of Fifteen Sovereigns, for his 28 months-old Leicester Ram; bred by himself.

William Sanday, of Holme Pierrepont, near Nottingham: the Prize of Twenty Sovereigns, for his pen of five 16 months-old Leicester Shearling Ewes; bred by himself.

William Sanday, of Holme Pierrepont, near Nottingham: the Prize of Ten Sovereigns, for his pen of five 16 months-old Leicester Shearling Ewes; bred by himself.

Sheep: *Southdown or other Short-woolled.*

Jonas Webb, of Babraham, near Cambridge: the Prize of Thirty Sovereigns, for his 17 months-old Southdown Shearling Ram; bred by himself.

Jonas Webb, of Babraham, near Cambridge: the Prize of Fifteen Sovereigns, for his 16 months-old Southdown Shearling Ram; bred by himself.

The Earl of Chichester, of Stanmer, near Lewes, Sussex: the Prize of Thirty Sovereigns, for his 40 months-old Southdown Ram; bred by himself.

William Sainsbury, of West Lavington, Wiltshire: the Prize of Fifteen Sovereigns, for his 29 months-old Southdown Ram; bred by himself.

The Earl of Chichester, of Stanmer, near Lewes, Sussex: the Prize of Twenty Sovereigns, for his pen of five 16 months-old Southdown Shearling Ewes; bred by himself.

The Duke of Richmond, of Goodwood, near Chichester, Sussex: the Prize of Ten Sovereigns, for his pen of five 16½ months-old Southdown Shearling Ewes; bred by himself.

Sheep: *Long Woolled* (not qualified to compete as Leicesters).

William Lane, of Eastington, near Northleach, Gloucestershire: the Prize of Twenty Sovereigns, for his 16 months-old Cotswold Longwoolled Shearling Ram; bred by himself.

William Garne, of Aldsworth, near Northleach, Gloucestershire: the Prize of Ten Sovereigns, for his 16 months-old Cotswold Longwoolled Shearling Ram; bred by himself.

William Lane, of Eastington, near Northleach, Gloucestershire: the Prize of Twenty Sovereigns, for his 40 months-old Cotswold Longwoolled Ram; bred by himself.

Robert Beman, of Moreton in the Marsh, Gloucestershire: the Prize of Ten Sovereigns, for his 40 months-old True Cotswold Longwoolled Ram; bred by himself at Broadwell, in Gloucestershire.

William Lane, of Eastington, near Northleach, Gloucestershire: the Prize of Ten Sovereigns, for his pen of five 16 months-old Cotswold Longwoolled Shearling Ewes; bred by himself.

William Lane, of Eastington, near Northleach, Gloucestershire: the Prize of Five Sovereigns, for his pen of five 16 months-old Cotswold Longwoolled Shearling Ewes; bred by himself.

Sheep: *Romney Marsh or Kentish.*

Sir Edward Cholmeley Dering, Bart., M.P., of Surrenden Dering, near Ashford, Kent: the Prize of Twenty Sovereigns, for his 39½ months-old Romney Marsh Ram; bred by himself.

Sir Edward Cholmeley Dering, Bart., M.P., of Surrenden Dering, near Ashford, Kent; the Prize of Ten Sovereigns, for his 51 months-old Romney Marsh Ram; bred by himself.

[The Award of the Prize of Ten Sovereigns for the best pen of five Four-toothed Romney Marsh Ewes, with their Lambs, was disqualified by Rule No. 19 of the Prize-sheet for the Lewes Meeting.]

Walter W. Daws, of Ewhurst, near Hurst Green, Sussex: the Prize of Ten Sovereigns, for his pen of five 51 months-old Romney Marsh Ewes; bred by the late Thomas Daws and himself.

Pigs.

Henry Blandford, of Sandridge, near Melksham, Wiltshire: the Prize of Fifteen Sovereigns, for his 2 years and 1 day-old Berkshire Boar, of a large breed; bred by himself.

Moses Cartwright, of Stanton Hill, near Burton on Trent, Staffordshire: the Prize of Five Sovereigns, for his 1 year and 2 months-old Stanton Boar, of a large breed; bred by himself.

Samuel Druce, Junr., of Eynsham, near Oxford: the Prize of Fifteen Sovereigns, for his 1 year and 2 weeks-old Oxfordshire and Essex Boar of a small breed; bred by himself.

Timothy Town, of Keighley, Yorkshire: the Prize of Five Sovereigns, for his 2 years and 1 month-old Boar of a small breed; bred by John G. Sudgen, of Steeton Hall, near Keighley, Yorkshire.

William Abbott, of Woodhouse Carr, near Leeds, Yorkshire: the Prize of Ten Sovereigns, for his 3 years and 9 months-old Sow of a large breed; bred by John Madgley, of Mearwood.

Mark Stainsby, Junr., of 30, Lady Pitt Lane, near Leeds, Yorkshire: the Prize of Ten Sovereigns, for his 1 year and 2 months-old Devonshire Sow of a small breed; bred by John Bartlett, of Lifton, Devonshire.

Samuel Munro, of Salford, Lancashire: the Prize of Ten Sovereigns, for his pen of three 7 months and 1 week old breeding Sow Pigs, of a large breed; bred by himself.

John Moon, of Lapford, near Crediton, Devonshire: the Prize of Ten Sovereigns, for his pen of three 7 months and 2 weeks-old Essex breeding Sow Pigs of a small breed; bred by himself.

Poultry.

Thomas Townley Parker, of Sutton Grange, near St. Helen's, Lancashire: the Prize of Five Sovereigns, for his 15 months-old Cock and two Hens of the grey Dorking breed; bred by himself.

Henry Blandford, of Sandridge, near Melksham, Wiltshire: the Prize of Three Sovereigns, for his 4 months and 2 weeks old Cock and two Pullets of the speckled Dorking breed; bred by himself.

James Lewry, of Handcross, Slaugham, near Crawley, Sussex: the Prize of Two Sovereigns, for his 5 months and 2 weeks-old Cock and two Hens of the Dorking breed; bred by himself.

Henry B. Higgs, of Hill Lodge, near Southampton, Hampshire: the Prize of Three Sovereigns, for his 5 months and 1 week old Cock and two Pullets of the Cochin China breed; bred by himself.

Henry B. Higgs, of Hill Lodge, near Southampton, Hampshire: the Prize of Two Sovereigns, for his 4 months old Cockerel and two Pullets of the Cochin China breed; bred by himself.

[The Judges decided to disqualify all Cocks of the Cochin China breed, in those cases where the principal tail feathers had been removed.]

George C. Adkins, of Edgbaston, near Birmingham: the Prize of Three Sovereigns, for his about 12 months-old Cock and two Hens of the black Polish breed; breeder unknown.

Joseph Tuley, of Matchless House, near Keighley, Yorkshire: the Prize of Two Sovereigns, for his 26 months-old Cock and two 14 months-old Hens, of the golden-spangled Hamburg breed; bred by John Driver, of Colne, Yorkshire.

Joseph Tuley, of Matchless House, near Keighley, Yorkshire: the Prize of Three Sovereigns, for his 26 months-old Cock and two Hens, of the Bolton grey pure breed; bred by himself.

William Ludlam, of Bradford, Yorkshire: the Prize of Two Sovereigns, for his 24 months-old Cock and two Hens, of the silver pheasant pure breed; bred by himself.

Henry Thomas Leigh, of Turnham Green, Middlesex: the Prize of Three Sovereigns, for his about 2 years old Cock and two Hens, of the golden bantam mixed breed; bred by himself.

[The Prize of Two Sovereigns offered by the Society for the second best Cock and two Hens, of any mixed breed, was withheld by the Judges.]

[The Prizes of Four Sovereigns and Two Sovereigns offered by the Society for the best and second best Cock and two Hen Turkeys were withheld by the Judges.]

Thomas Townley Parker, of Sutton Grange, near St. Helen's, Lancashire: the Prize of Three Sovereigns, for his 3 months and 2 weeks-old Gander and two Geese, of the Toulouse breed; bred by himself.

Robert Glover, of Holt Hall, near Fazeley, Staffordshire: the Prize of Two Sovereigns, for his (age unknown) Gander and two Geese, of the white breed; bred by the Rev. John Robinson, of Widmerpool, near Nottingham.

Robert Glover, of Holt Hall, near Fazeley, Staffordshire: the Prize of Two Sovereigns, for his about 2 years old Drake and two Ducks, of the white Aylesbury breed; bred by himself.

[The Prize of One Sovereign offered by the Society for the second best Drake and two Ducks, of the Aylesbury or any other white variety, was withheld by the Judges.]

Thomas Townley Parker, of Sutton Grange, near St. Helen's, Lancashire: the Prize of Two Sovereigns, for his 12 months and 2 weeks-old Drake and two Ducks, of the Rouen breed; bred by himself.

The Earl of March, of Molecomb, near Chichester, Sussex: the Prize of One Sovereign, for his 2 years old Drake and two 10 months-old Ducks, of the wild breed; bred by himself.

[No entry was made for the Prizes of Two Sovereigns and One Sovereign offered by the Society for the best and second best Guinea Fowls.]

Commendations.

LORD FEVERSHAM, of Duncombe Park, near Helmsley: a pure Short-horned Bull; bred by himself.

*RICHARD BOOTH, of Warlaby, near Northallerton: a Short-horned In-milk Cow; bred by himself.

*JOHN KIRKHAM, of Hagnaby, near Spilsby: a pure Short-horned In-calf Heifer; bred by himself.

LORD BERNERS, of Keythorpe Hall, near Tugby: a Short-horned In-calf Heifer; bred by himself.

CHARLES TOWNELEY, of Towneley Park, near Burnley: a pure Short-horned Yearling Heifer; bred by himself.

JOHN KIRKHAM, of Hagnaby, near Spilsby: a pure Short-horned Yearling Heifer; bred by himself.

*WILLIAM PERRY, of Cholstrey, near Leominster: a Hereford Bull; bred by himself.

JOSEPH CRADDOCK, of Eastington, near Northleach: a Hereford Bull; bred by himself.

*JOHN WALKER, of Westfield House, Holmer, near Hereford: a Hereford Bull; bred by himself.

*The EXECUTORS of the late Rev. J. R. SMYTHIES, of Lynch Court, near Leominster: a pure Hereford In-milk and In-calf Cow; bred by Samuel Aston, late of Lynch Court.

WILLIAM JAMES, of Hereford: a pure Hereford In-milk Cow; bred by the late John Jones, of Lower Breinton, near Hereford.

*WALTER MAYBERY, of Penlan, near Brecon: a Hereford In-calf Heifer; bred by himself.

The EXECUTORS of the late Rev. J. R. SMYTHIES, of Lynch Court, near Leominster: a Hereford Yearling Heifer; bred by the late Rev. J. R. Smythies.

SAMUEL ANSTEY, of Monabilly Farm, Fowey: a pure North Devon Bull; bred by John Quartly, of Champson Molland.

The EARL of LEICESTER, of Holkham, near Wells: a North Devon in-Calf Cow; bred by himself.

*SAMUEL UMBERS, of Wappenbury, near Leamington: a pure North Devon In-calf Heifer; bred by himself.

*GEORGE TURNER, of Barton, near Exeter: a North Devon In-calf Heifer; bred by himself.

*WILLIAM M. GIBBS, of Bishop's Lydeard, near Taunton: a Devon In-milk Heifer; bred by himself.

*THOMAS MILLER, of Castle Farm, near Sherborne: a pure Devon In-calf Heifer; bred by himself.

*JAMES HOLE, of Knowle House, near Dunster: a pure Devon In-calf Heifer; bred by himself.

*JOHN TANNER DAVY, of Rose Ash, near South Molton: a pure North Devon Yearling Heifer; bred by himself.

*GEORGE TURNER, of Barton, near Exeter: a North Devon Yearling Heifer; bred by himself.

*WILLIAM BAKER, of Bishop's Nympton, near South Molton: a North Devon Yearling Heifer: bred by himself.

*JAMES HOLE, of Knowle House, near Dunster: a pure Devon Yearling Heifer: bred by himself.

*James Hole, of Knowle House, near Dunster: a pure Devon Yearling Heifer; bred by himself.

Robert Chatfield, of Greatham House, near Petworth: a pure Sussex Bull; bred by himself.

Thomas Child, of Michelham, near Hailsham: a true Sussex Bull; bred by Josias Pitcher, of Westham.

*Arthur and Thomas Barton, of Bexhill, near Battle: a Sussex In-milk Cow; bred by themselves.

*Edward Cane, of Berwick, near Lewes: a Sussex In-milk and In-calf Cow; bred by himself.

*Henry Catt, of West Firle, near Lewes: a Sussex In-milk and In-calf Cow; bred by himself.

*Henry Catt, of West Firle, near Lewes: a Sussex In-milk Cow; bred by himself.

*James Skinner, of Sherrington House, Selmeston, near Lewes: a Sussex In-milk Cow; bred by himself.

*Robert Willis Blencowe, of The Hooke, near Lewes: a Sussex In-milk Cow; bred by himself.

*James Gorringe, of Selmeston, near Lewes: a pure Sussex In-milk and In-calf Cow; bred by himself.

*William Marshall, of Bolney Place, Bolney, near Cuckfield: a Sussex In-milk Cow; bred by himself.

*William Marshall, of Bolney Place, Bolney, near Cuckfield: a Sussex In-milk Cow; bred by himself.

*Jeremiah Smith, of Springfield Lodge, near Rye: a Sussex In-milk Cow; bred by himself.

*Richard Smith, of Sedlescomb, near Battle: a Sussex In-calf Cow; bred by himself.

*Richard Smith, of Sedlescomb, near Battle: a Sussex In-calf Cow; bred by himself.

*William Botting, of Poynings, near Hurstperpoint: a Sussex In-milk Cow; bred by himself.

*Thomas Child, of Michelham, near Hailsham: a true Sussex In-milk and In-calf Cow; bred by himself.

*William Peel Croughton, of Heronden, near Tenterden: a Sussex In-milk and In-calf Cow; bred by himself.

*Josiah Pitcher, of Westham, near Eastbourne: a pure Sussex In-calf Cow; bred by himself.

*Josiah Pitcher, of Westham, near Eastbourne: a pure Sussex In-milk Cow; bred by Tilden Smith, of Knell Farm, Beckley.

*Tilden Smith, of Beckley, near Staplehurst: a Sussex In-milk Cow; bred by Samuel Selmes, of Croydon.

*Tilden Smith, of Beckley, near Staplehurst: a Sussex In-milk and In-calf Cow; bred by Samuel Selmes, of Croydon.

*W. King Sampson, of Westham, near Eastbourne: a Sussex In-milk and In-calf Cow; bred by C. Langford, of Beechwood Farm, near Lewes.

*James Skinner, of Selmeston, near Lewes: a Sussex In-milk Cow; bred by himself.

Arthur and Thomas Barton, of Bexhill, near Battle: a Sussex In-calf Heifer; bred by themselves.

Arthur and Thomas Barton, of Bexhill, near Battle: a Sussex In-calf Heifer; bred by themselves.

Arthur and Thomas Barton, of Bexhill, near Battle: a Sussex In-calf Heifer; bred by themselves.

Henry Catt, of West Firle, near Lewes: a Sussex In-Calf Heifer: bred by himself.

Henry Catt, of West Firle, near Lewes: a Sussex In-Calf Heifer; bred by himself.

James Gorringe, of Selmeston, near Lewes: a pure Sussex In-Calf Heifer; bred by himself.

James Gorringe, of Selmeston, near Lewes: a pure Sussex In-Calf Heifer; bred by himself.

William Marshall, of Bolney Place, Bolney, near Cuckfield: a Sussex In-Calf Heifer; bred by himself.

William Marshall, of Bolney Place, Bolney, near Cuckfield: a Sussex In-calf Heifer; bred by himself.

Jeremiah Smith, of Springfield Lodge, near Rye: a Sussex In-calf Heifer; bred by himself.

Richard Smith, of Sedlescomb, near Battle: a Sussex In-calf Heifer; bred by himself.

James Singer Turner, of Chinton Farm, near Seaford: a Sussex In-calf Heifer: bred by himself.

Thomas Child, of Michelham, near Hailsham: a true Sussex In-calf Heifer; bred by himself.

Thomas Child, of Michelham, near Hailsham: a true Sussex In-calf Heifer; bred by himself.

William Peel Croughton, of Heronden, near Tenterden: a Sussex In-calf Heifer; bred by himself.

William Verrall, of Southover, near Lewes: a Sussex In-calf Heifer; bred by himself.

John Boswell, of Iver, near Uxbridge: a Channel Islands Bull; bred by himself.

*Richard James Webb, of 53, Brompton-row, and of Calcot, near Reading: a Guernsey Bull; breeder unknown.

George David Badham, of the Sparrow's Nest, Thurleston, near Ipswich: a Suffolk Bull; bred by himself.

*William Tod, of Elphinstone Tower, near Tranent, Haddington: a West Highland Bull; bred by John Cameron, of Conychoila, Argyleshire.

*Henry Danby Seymour, M.P., of East Knoyle, near Hindon: a pure Suffolk Agricultural Stallion; bred by Thomas Catlin, of Butley Abbey.

Edward Browning, of Bulmer, near Sudbury: a Roadster Stallion; bred by George Morgan, of Sycamore House, Bramford.

*Thomas Addington, of Wyboston, near St. Neot's: a Suffolk Agricultural Mare and Foal; the mare bred by himself—sire of foal belonged to Mr. George Manning, of Elston.

Jacob Watson, of Easington, Chilton, near Thame: a Suffolk Agricultural Mare and Foal; the mare bred by the late William Godfrey, of Kennett—sire of foal belonged to Thomas Beards, of Stowe.

The Hon. and Rev. James Norton, of Anningsley Park, near Chertsey: a Cart Filly; bred by himself.

Nathaniel George Barthropp, of Cretingham Rookery, near Woodbridge: a Suffolk Filly; bred by himself.

Thomas Edward Pawlett, of Beeston, near Biggleswade: a Leicester Ram; bred by himself.

Thomas Edward Pawlett, of Beeston, near Biggleswade: a Leicester Ram; bred by himself.

William Sanday, of Holme Pierrepoint, near Nottingham: a Leicester Ram; bred by himself.

*William Sanday, of Holme Pierrepoint, near Nottingham: a Leicester Ram; bred by himself.

*Thomas Edward Pawlett, of Beeston, near Biggleswade: a Leicester Ram; bred by himself.

*William Sanday, of Holme Pierrepoint, near Nottingham: a Leicester Ram; bred by himself.

William Sainsbury, of West Lavington: a Southdown Ram; bred by himself.

The Duke of Richmond, of Goodwood, near Chichester: a Southdown Ram; bred by himself.

*Jonas Webb, of Babraham, near Cambridge: a Southdown Ram; bred by himself.

*Jonas Webb, of Babraham, near Cambridge: a Southdown Ram; bred by himself.

*Thomas Robinson, of Burton-on-Trent: a pure Southdown Ram; bred by himself.

*William Sainsbury, of West Lavington: a Southdown Ram; bred by himself.

*William Rigden, of Hove, near Brighton: a pen of five Southdown Ewes; bred by himself.

Thomas Ellman, of Beddingham, near Lewes: a pen of five Southdown Ewes; bred by himself.

*Henry Lugar, of Hengrave, near Bury St. Edmonds: a pen of five Southdown Ewes; bred by himself.

Sir Edward C. Dering, Bart., M.P., of Surrenden Dering, near Ashford: a Romney Marsh Ram; bred by himself.

Sir Edward C. Dering, Bart., M.P., of Surrenden Dering, near Ashford: a Romney Marsh Ram; bred by himself.

*William Hewer, of Sevenhampton, near Highworth: a Berkshire Boar, of a large breed; bred by himself.

*William Hainworth, of Hitchin: a Boar, of a large breed; bred by himself.

George Edward Taylor, of Oatlands, near Leeds: an improved Boar, of a large breed; bred by John Boyle, of Leeds.

Samuel Umbers, of Wappenbury, near Leamington: a Yorkshire Boar, of a small breed; bred by himself.

James Gorringe, of Selmeston, near Lewes: a Sussex Boar, of a small breed; bred by himself.

William Ludlam, of Bradford: a Boar, of a small breed; bred by himself.

*John Moon, of Lapford, near Crediton: an Essex Boar, of a small breed; bred by W. Fisher Hobbs, of Boxtead Lodge, near Colchester.

John Hillman, Junr., of Lewes: a Lincoln Sow, of a large breed; breeder unknown.

*John Hillman, Junr., of Lewes: a Lincoln Sow, of a large breed; breeder unknown.

Joseph Tuley, of Matchless House, near Keighley: a Sow, of a large breed; bred by himself.

Samuel Druce, Jun., of Eynsham, near Oxford: an Oxfordshire and Essex Sow, of a small breed; bred by himself.

*Samuel Druce, Jun., of Eynsham, near Oxford: an Oxfordshire and Essex Sow, of a small breed; bred by himself.

*George Mangles, of Givendale, near Ripon: a Sow, of a small breed; bred by himself.

William Mills Barber, of Langley Broom, near Slough: a Berkshire and Essex Sow, of a small breed; bred by himself.

Rev. Edward Elmhirst, of Shawell, near Lutterworth: a Yorkshire Sow, of a small breed; bred by Matthew Pemberton, of Gibraltar Works, Leeds.

*John Moon, of Lapford, near Crediton: an Essex Sow, of a small breed, bred by himself.

Samuel Munro, of Salford: a Sow, of a small breed; bred by himself.

William Mills Barber, of Langley Broom, near Slough: a pen of three improved Berkshire Sow Pigs, of a large breed; bred by himself.

Robert Fookes, of Milton Abbas, near Blandford: a pen of three Essex and Dorset Sow Pigs, of a small breed; bred by himself.

Sir John Conroy, Bart., of Arborfield Hall, near Reading: a pen of three Arborfield improved Berkshire Sow Pigs, of a small breed; bred by himself.

Henry Blandford, of Sandridge, near Melksham: a Speckled Dorking Cock and two Hens; bred by himself.

*James Lewry, of Handcross, Slaugham, near Crawley: a Speckled Dorking Cock and two Hens; bred by himself.

William Ludlam, of Bradford: a pure Silver Pheasant Cock and two Hens; bred by himself.

These Commendations are arranged in the order of the numbers of the Certificates to which they refer. The mark (*) signifies "highly commended;" the omission of it, "commended;" by the Judges.

IMPLEMENTS.

Ransomes and Sims, of Ipswich, for their Plough best adapted for general purposes . . . . Seven Sovereigns.

William Busby, of Newton-le-Willows, Yorkshire, for his Plough best adapted for Deep-Ploughing . . . . Seven Sovereigns.

Ransomes and Sims, of Ipswich, for their One-way or Turn-wrest Plough, Seven Sovereigns.

Thomas Glover, of Thrussington, Leicestershire, for his Paring Plough, Five Sovereigns.

J. Gray and Co., of Uddingston, N. B., for their Subsoil Pulverizer, Five Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Drill for general purposes . . . Ten Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Steerage Corn and Turnip Drill . . Ten Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Drill for Small Occupations . . . . Five Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their economical Small-occupation Seed and Manure Drill for Flat or Ridged Work, Five Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Turnip Drill on the Flat . . . . Ten Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Turnip Drill on the Ridge . . . Ten Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Drop Drill, for depositing Seed and Manure . . . . Ten Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Manure Distributor Five Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Portable Steam-Engine, not exceeding 6-horse power, applicable to Thrashing or other agricultural purposes . . Forty Sovereigns.

Barrett, Exall, and Andrewes, of Katesgrove Iron Works, Berkshire, for their second-best Portable Steam-Engine, not exceeding 6-horse power, applicable to Thrashing or other agricultural purposes, Twenty Sovereigns.

Barrett, Exall, and Andrewes, of Katesgrove Iron Works, Berkshire, for their Fixed Steam-Engine, not exceeding 8-horse power, applicable to Thrashing or other agricultural purposes . . Twenty Sovereigns.

Ransomes and Sims, of Ipswich, for their second-best fixed Steam Engine, not exceeding 8-horse power, applicable to thrashing or other agricultural purposes . . . . Ten Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Portable Thrashing Machine, not exceeding 2-horse power, for small occupations, Ten Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Portable Thrashing Machine, not exceeding 6-horse power, for larger occupations, Twenty Sovereigns.

Clayton, Shuttleworth, and Co., of Lincoln, for their Portable Thrashing Machine, not exceeding 6-horse power, with shaker and riddle: to be driven by steam . . . . . . Twenty Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Fixed Thrashing Machine, not exceeding 6-horse power, with straw-shaker, riddle, and winnower, that will best prepare the corn for the finishing dressing-machine, to be driven by steam . . . Twenty Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Corn-dressing Machine . . . . Ten Sovereigns.

George Hurwood, of Ipswich, for his Grinding-Mill for breaking agricultural produce into fine meal . . . . Ten Sovereigns.

William Prockter Stanley, of Peterborough, for his Linseed and Corn Crusher . . . . Five Sovereigns.

Richmond and Chandler, of Salford, Lancashire, for their Chaff-Cutter, to be worked by horse or steam power . . . Ten Sovereigns.

James Cornes, of Barbridge, Cheshire, for his Chaff-Cutter, to be worked by hand-power . . . . . . Five Sovereigns.

Bernhard Samuelson (Successor to the late James Gardner), of Banbury, for his Turnip-Cutter . . . . . Five Sovereigns.

Richard Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Oil-cake Breaker for every variety of cake . Five Sovereigns.

William Busby, of Newton-le-Willows, Yorkshire, for his One-Horse Cart for general purposes . . . . . Ten Sovereigns.

William Ball, of Rothwell, Northamptonshire }
William Crosskill, of Beverley Iron Works } for their Light Waggon for general purposes (equal merit) . . . Ten Sovereigns.

Thomas Scragg, of Calveley, Cheshire, for his Machine for making Draining Tiles or Pipes for agricultural purposes . . Twenty Sovereigns.

Mapplebeck and Lowe, of Birmingham, for their Instruments for Hand-use in Drainage . . . . Three Sovereigns.

William Williams, of Bedford, for his Heavy Harrow, Five Sovereigns.

James and Frederick Howard, of Bedford, for their Light Harrow, Five Sovereigns.

Ransomes and Sims, of Ipswich, for their Cultivator, Grubber, and Scarifier, Ten Sovereigns.

Charles Hart, of Wantage, Berkshire, for his Pair-Horse Scarifier, Five Sovereigns.

Richard Garrett and Son, of Leiston, Suffolk, for their Horse Hoe on the Flat . . . . Ten Sovereigns.

John Howard and Son, of Bedford, for their Horse Hoe on the Ridge, Five Sovereigns.

John Howard and Son, of Bedford, for their Horse Rake, Five Sovereigns.

[The Prize of Ten Sovereigns for the Horse Seed-Dibbler, or Seed Depositor, not being a drill, was withheld by the Judges.]

Barrett, Exall, and Andrewes, of Katesgrove Iron Works, Berkshire, for their Gorse-Bruiser . . . . . Five Sovereigns.

William Prockter Stanley, of Peterborough, for his economical Steaming Apparatus for general purposes . . . Five Sovereigns.

Edward Hammond Bentall, of Heybridge, Essex, for his Dynamometer, especially applicable to the traction of Ploughs . Five Sovereigns.

[The Prize of Ten Sovereigns for the best Plough to fill in the Soil cast out of Drains, with not more than 4 horses, two and two abreast (offered by R. A. Slaney, Esq., M.P.), was withheld by the Judges.]

Richard Garrett and Son, of Leiston, Suffolk, for their Reaping Machine, Silver Medal.

James and Frederick Howard, of Bedford, for their Improvement in Plough Wheels . . . . Silver Medal.

Tasker and Fowle, of Waterloo Iron Works, Hampshire, for their Well Machinery . . . . Silver Medal.

Burgess and Key, of Newgate-street, London, for their Digging Forks and Farm Tools . . . . Silver Medal.

Ransomes and Sims, of Ipswich, for their Patent Double Mill, for Hand-Power . . . . Silver Medal.

COMMENDATIONS.

*Henry Kearsley, of Ripon, for his Norwegian Harrow.

*Mapplebeck and Lowe, of Birmingham, for their American Digging Forks and Farm Tools.

*E. H. Bentall, of Heybridge, for his Combined Broadshare Subsoil Plough.

*William Crosskill, of Beverley, for his Reaping Machine.

*R. Garrett and Son, of Leiston Works, Suffolk, for their Drill for General Purposes.

*R. Garrett and Son, of Leiston Works, Suffolk, for their Drill for Turnips and Mangold Wurzel on the Ridge.

*R. Garrett and Son, of Leiston Works, Suffolk, for their Portable Steam Engine.

*R. Hornsby and Son, of Spittlegate Iron Works, Lincolnshire, for their Portable Steam Engine.

*Clayton, Shuttleworth, and Co., of Lincoln, for their Portable Steam Engine.

*Richard Read, of Regent Circus, Piccadilly, London, for his Patent Injecting Instrument.

*H. A. Thompson, of Lewes, for his Eccentric Lever Hinges for Gates.

*R. GARRETT and SON, of Leiston Works, Suffolk, for their Corn and Seed Drill.

*EDWARD HILL and Co., of Brierley Hill, for their Small Weighing Machine.

*BARNARD and BISHOP, of Norwich, for their Window Frame and Fastener.

*R. HORNSBY and SON, of Spittlegate Iron Works, Lincolnshire, for their Fixed Steam Engine.

SMITH and ASHBY, of Stamford, for their Haymaking Machine.

JOSHUA COOCH, of Harleston, Northamptonshire, for his Sack Holder.

COTTAM and HALLEN, of Winsley Street, London, for their Odometer, or Land Measure.

JOHN SMITH, of Uxbridge, for his Gravel Screen.

EDWARD HILL and Co., of Brierley Hill, for their Hurdle.

WILLIAM CROSSKILL, of Beverley, for his Root Washer.

RICHARD READ, of Regent Circus, Piccadilly, London, for his Garden Engine.

BURGESS and KEY, of Newgate Street, London, for their American Churn.

EDWARD HILL and Co., of Brierley Hill, for their Wrought Iron Field Gate.

H. A. THOMPSON, of Lewes, for his Steel Waggon Hames.

RANSOMES and SIMS, of Ipswich, for their Patent Trussed Iron Whippletrees.

HOLMES and SONS, of Norwich, for their One-Horse Seed Harrow.

WILLIAM DRAY and Co., of Swan Lane, London, for their Flax Seeding Machine.

JOHN EATON, of Woodford, Northamptonshire, for his Portable Steam Engine.

RANSOMES and SIMS, of Ipswich, for their Portable Steam Engine.

CLAYTON, SHUTTLEWORTH, and Co., of Lincoln, for their Portable Steam Engine.

TUXFORD and SONS, of Boston, for their Portable Steam Engine.

[The mark (*) signifies "HIGHLY COMMENDED;" the omission of it, "COMMENDED;" by the Judges.]

MEMORANDA.

GENERAL MEETING in London on Saturday the 11th of December, 1852.

GENERAL MAY MEETING in London, on Monday, May 23, 1853.

COUNTRY MEETING at Gloucester, in the month of July or August, 1853.

GENERAL MEETING in London, on the Saturday in the week of the Smithfield Club Show, in December, 1853.

MONTHLY COUNCIL (for legislative business), at 12 o'clock on the first Wednesday in every month, excepting Jan., Sept., Oct., and Nov.: open only to Members of Council and Governors.

WEEKLY COUNCIL (for practical communications), at 12 o'clock on all Wednesdays in Feb., March, April, May, June, and July, excepting the first Wednesday in each of those months: open to all Members of the Society.

ADJOURNMENTS.—The Council adjourn over Passion, Easter, and Whitsun weeks; from the first Wednesday in August to that in November; and from the second Wednesday in December to the first Wednesday in February.

GUANO analysed for Members by Prof. WAY (at 23, Holles Street, Cavendish Square, London), at 5*s*. for a partial analysis, and at 10*s*. for a complete analysis.

DISEASES of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society, and of sending animals to the Royal Veterinary College, on the same terms as if they were subscribers to the College (Journal, vol. XI., Appendix, pp. viii, ix; vol. XII., Appendix, p. iv.).

PRIZES for Essays and Reports, 1853 and 1854: terms and conditions given in this Part of Journal (Appendix, pp. xxviii–xxxi). Essays to be sent to the Secretary by the 1st of March in each year.

PRIZES for Implements, 1853: terms given in this Journal (Appendix, pp. xxiv–xxv). The conditions and general regulations will be determined and published at the end of the current year 1852.

CERTIFICATES for Implements to be sent to the Secretary by the 1st of May, 1853.

CERTIFICATES for Live-Stock to be sent to the Secretary by the 1st of June, 1853.

Royal Agricultural Society of England.

ANNUAL COUNTRY MEETING OF 1853,

TO BE HELD AT

THE CITY OF GLOUCESTER,

FOR THE SOUTH-WALES DISTRICT, COMPRISING THE WHOLE OF SOUTH WALES, WITH THE ADDITION OF THE COUNTIES OF GLOUCESTER, HEREFORD, MONMOUTH, AND WORCESTER.

Prizes for Agricultural Implements and Machinery.

[*The Conditions for their Competition, and general Regulations for their Exhibition and Trial, will be determined and published at the end of the current year* (1852).]

All Prizes of the Royal Agricultural Society of England are open to general competition: Members of the Society having the privilege of a free entry; while non-Subscribers are allowed to compete on the payment of 5*s*. on each Certificate.

Forms of Certificate may be obtained on application to the Secretary, 12, Hanover-square, London. All Certificates for the entry of Implements, &c., must state the total number of articles entered to be shown by each Exhibitor, and the space required for their exhibition; and must be returned, filled up, to the Secretary, on or before the 1st of May, 1853: the Council having decided that in no case whatever shall any Certificate of Implements be received after that date.

No. of Prize.	Prizes.	£
1.	For the Plough best adapted for general purposes	7
2.	For the Plough best adapted for Deep Ploughing	7
3.	For the best One-way or Turn-wrest Plough	7
4.	For the best Paring Plough	5
5.	For the best Dynamometer, especially applicable to the traction of ploughs, and indicating the extent of work done	5
6.	For the best Subsoil Pulverizer	5
7.	For the best Machine for making Draining Tiles or Pipes for agricultural purposes	10
8.	For the best Instruments for Hand-use in Drainage	3
9.	For the best Heavy Harrow	5
10.	For the best Light Harrow	5
11.	For the best Cultivator, Grubber, and Scarifier	10
12.	For the best Pair-Horse Scarifier	5
13.	For the best Drill for general purposes	10
14.	For the best Steerage Corn and Turnip Drill	10
15.	For the best Drill for small occupations	5
16.	For the best and most economical Small-occupation Seed and Manure Drill for flat or ridged work	5
17.	For the best Turnip Drill on the flat	10

No. of Prize.		£
18.	For the best Turnip Drill on the ridge	10
19.	For the best Dropping Machine, for depositing seed and manure	10
20.	For the best Manure Distributor	10
21.	For the best Horse Hoe on the flat	5
22.	For the best Horse Hoe on the ridge	5
23.	For the best Collection of Agricultural Tools for hand-labour	5
24.	For the best Reaping Machine	20
25.	For the best Mowing Machine for natural and artificial grasses	10
26.	For the best One-Horse Cart for general purposes	5
27.	For the best Light Waggon for general purposes	10
28.	For the best Portable Steam-Engine, not exceeding 6-horse power, applicable to Thrashing or other agricultural purposes	20
..	For the second-best ditto, ditto	10
29.	For the best Fixed Steam-Engine, not exceeding 8-horse power, applicable to Thrashing or other agricultural purposes	20
..	For the second-best ditto, ditto	10
30.	For the best Portable Thrashing Machine, not exceeding 2-horse power, for small occupations	10
31.	For the best Portable Thrashing Machine, not exceeding 6-horse power, for larger occupations	15
32.	For the best Portable Thrashing Machine, not exceeding 6-horse power, with shaker, riddle, and winnower, that will best prepare the corn for the finishing dressing-machine: to be driven by steam	20
33.	For the best Fixed Thrashing Machine, not exceeding 6-horse power, with straw-shaker, riddle, and winnower, that will best prepare the corn for market: to be driven by steam	20
34.	For the best Corn-dressing Machine	5
35.	For the best ditto ditto, for small occupations	5
36.	For the best Grinding-Mill for breaking agricultural produce into meal	10
37.	For the best Linseed and Corn-Crusher	5
38.	For the best Chaff-Cutter, to be worked by horse or steam power	10
39.	For the best Chaff-Cutter, to be worked by hand-power	5
40.	For the best Turnip-Cutter	5
41.	For the best Oilcake-Breaker for every variety of cake	5
42.	For the best ditto, for thin cake	3
43.	For the best and most economical Steaming Apparatus for general purposes	5
44.	For the best and most economical Machine for preparing unsteeped Flax-straw for market, by manual or other labour	10
45.	For the best Churn	3
46.	Miscellaneous Awards and Essential Improvements, Fourteen Silver Medals, estimated at	21
47.	For the Invention of any New Implement, such sum as the Council may think proper to award	—

General Meetings in 1852–3.

The General December Meeting, in London, on Saturday the 11th of December, 1852.

The General May Meeting, in London, on Monday, May 23, 1853.

The Annual Country Meeting, at Gloucester, in the month of July or August, 1853.

The General December Meeting, in London, on the Saturday in the week of the Meeting of the Smithfield Club in December, 1853.

Election, &c., of Members.

Nomination.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the name, rank, usual place of residence, and post-town, of the candidate, either at a Council or by letter to the Secretary. Every such proposal shall be read at the Council at which such proposal is made; or, in the case of the candidate being proposed by a letter to the Secretary, at the first meeting of the Council next after such letter shall have been received.

Election.—At the next monthly meeting of the Council the election shall take place, when the decision of the Council shall be taken by a show of hands; the majority of the Members present to elect or reject. The Secretary shall inform Members of their election by a letter, in such form as the Council may from time to time direct.

Payments.—1. Annual.—The subscription of a Governor is 5*l.*, and that of a Member 1*l.*, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. Members elected in November or December may date the commencement of their liabilities and privileges with the Society from the 1st of January in the ensuing year. 2. For Life.—Governors may compound for subscription during future life by paying at once the sum of 50*l.*, and Members by paying 10*l.* No Governor or Member in arrear of subscription can be allowed to enter into composition for life until such arrears have been paid.

Privileges.—The Journals of the Society for the year during which their subscription has been paid, transmitted by post, free of charge, to their address; analyses performed at a reduced charge by the consulting chemist; the liberty of attending all weekly meetings of the Council and lectures delivered before the Members in London, and of consulting the books in the library; leave to report the outbreak of disease amongst live stock, and to request the personal attendance of the Society's veterinary inspector; free entry of stock, and priority of claim for dinner and lecture tickets, at the Country Meetings of the Society. No Member in arrear of his subscription is entitled to any of the privileges of the Society.

Liabilities.—All Members belong to the Society, and are bound to pay their annual subscriptions, until they shall withdraw from it by a notice in writing to the Secretary.

Resignation.—Members can only withdraw their names legally from the Society by a written notice to the Secretary, and the payment of all subscriptions due from them at the date of such notice.

Expulsion.—Members may be dismissed from the Society in the following manner:—Any ten Members of the Society may send, in writing, signed by their names, to the Council a request that any Member of the Society shall be dismissed from the Society. Such request shall be placed in a conspicuous part of the council-room, and a copy thereof transmitted by the post to the Member proposed to be so dismissed, signed by the Secretary. At the Monthly Meeting of the

Council which shall take place next after one month shall have elapsed after such request shall have been placed in the council-room, the Council shall take the matter thereof into their consideration; but the Council shall not so take it into consideration unless twelve Members of the Council at the least shall be present. If this number is not present, the consideration of the request shall be adjourned to the next monthly meeting of the Council, and so on 'till a monthly meeting shall take place at which twelve Members are present. If the Council so constituted shall unanimously agree to the dismissal of such Member, he shall be no longer a Member of the Society; but if they do not unanimously agree to his dismissal, their decision shall be considered to have been made in his favour: Provided always, that his dismissal shall not relieve him from the payment of any debt previously due by him to the Society; and that, if a Life-Governor or Life-Member, he shall not have any claim to any portion of the commutation he has paid.

Payment of Subscription.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the office of the Society, No. 12, Hanover-square, London, between the hours of ten and four, or by means of post-office orders, to be obtained on application at any of the principal post-offices throughout the kingdom, and made payable to him at the General Post-office, London; but any cheque on a banker's or other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct Christian name and surname of the Secretary of the Society, otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight, or a certain number of days after date), and should be drawn on a London (not a local country) banker. When payment is made to Messrs. Drummond, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin should be remitted by post. *As local cheques on country bankers are not payable in London, and will not be received as cash by the Society's bankers, it will be desirable that post-office orders, payable in London, should be sent in lieu of them.*

Journal.—The Parts of the Society's Journal are published half-yearly (the first Part of each year making its appearance about the end of July or the beginning of August); and (when the subscription is not in arrear) they are forwarded by post to Members residing in the country, or are delivered personally, at the Society's office, to Members, or to the bearer of their written order. They can also be delivered free at any address in Town, excepting that of a London bookseller: but although the arrangements of booksellers in many cases render such channel of transmission an inconvenient one to all parties, the Journals will be delivered at the Society's office to the collectors of booksellers, on their presenting a Member's written order for the same. Should no special instruction be given by a Member for the transmission of his Journal, the copies, as a matter of course, will be transmitted to him by post, as published, to such address as may stand against his name in the official list of the Society. As packets become liable to a renewal of postage-stamps on re-direction from one place in the country to another, it is important that all changes of address should be notified to the Secretary as they occur. All the back numbers of the Journal are kept constantly on sale by the publisher, John Murray, 50, Albemarle Street.

Essays and Reports.

PRIZES FOR 1853 AND 1854.

All Prizes of the Royal Agricultural Society of England are open to general competition.

I.—PRIZES FOR 1853.

Competitors will be expected to consider and discuss the heads enumerated.

I. Farming of Herefordshire.

Fifty Sovereigns will be given for the best Report on the Farming of Herefordshire.

1. The character of the soils and subsoils of the county.
2. The use of lime as manure, to what soils (if any) it is confined, and whether its employment is at all diminished by high farming.
3. Manufacture of perry.
4. Breed of cattle.
5. Effect of soil on the growth of timber-trees.
6. The suitableness or otherwise of the farm buildings to improved husbandry.
7. The extent of under-draining effected in the county.
8. Improvements made since the Report of J. Duncombe in 1805, and to what extent still required.

II. Farming of Surrey.

Fifty Sovereigns will be given for the best Report on the Farming of the county of Surrey.

1. The character of the soils and subsoils of the county.
2. The use of lime as manure, to what soils (if any) it is confined, and whether its employment is at all diminished by high farming.
3. Interference of small inclosures with improved husbandry.
4. Effect of soil on the growth of timber-trees.

5. The suitableness or otherwise of the farm buildings to improved husbandry.
6. The extent of under-draining effected in the county.
7. Improvements made since the Report of William Stevenson in 1813, and to what extent still required.

III. Farming of Derbyshire.

Fifty Sovereigns will be given for the best Report on the Farming of Derbyshire.

1. The character of the soils and subsoils of the county.
2. The use of lime as manure, to what soils (if any) it is confined, and whether its employment is at all diminished by high farming.
3. Breed of cattle.
4. Effect of soil on the growth of timber-trees.
5. The suitableness or otherwise of the farm buildings to improved husbandry.
6. The extent of under-draining effected in the county.
7. Improvements made since the Report of John Farey, sen., in 1815, and to what extent still required.

IV. Heavy Land Farming.

Thirty Sovereigns will be given for the best Essay on the Management of Heavy Lands, containing little or no calcareous matter, and in which clay is the principal ingredient, such as those on the London Clay, Weald Clay, Oxford Clay, and the Clay of the Coal Measures, &c.

1. General management.
2. Mode of drainage on arable and grass land respectively.
3. Manner in which greatest amount of stock can be profitably kept, where it is impossible to feed off turnips upon the land.
4. Necessity for or power of dispensing with naked fallows.

V. Light Land Farming.

Thirty Sovereigns will be given for the best Essay on the Management of Light Lands, consisting principally of very friable, dry, and loose sand, with some aluminous (or clayey), but no calcareous matter, such as those on Sand of the Plastic Clay, Iron-sand, Millstone Grit, Old Red Sandstone, and Granite.

1. General management.
2. Most profitable method of keeping sheep stock.
3. Most profitable method of converting straw into dung.
4. Rotation of crops (including spring-feed) which keeps the land most constantly under crop.

VI. Beans and Peas.

Ten Sovereigns will be given for the best Essay on the cultivation of Beans and Peas.

1. Previous preparation of land by manure or otherwise.
2. Varieties of beans and peas, whether sown in autumn or spring.
3. Diseases and mode of prevention, if any.

VII. Hereditary Diseases and Defects.

Twenty Sovereigns will be given for the best account of those Diseases in the Sheep and the Pig, which either are or may become hereditary.

VIII. Any other Agricultural Subject.

Twenty Sovereigns will be given for the best Essay on any other Agricultural subject.

The Essays must be sent to the Secretary, at 12, *Hanover Square, London, on or before March* 1, 1853.

II.—PRIZE FOR 1854.

Guano.

Fifty Sovereigns will be given for the best account of the Geographical Distribution of Guano; with suggestions for the discovery of any new source of supply, accompanied by specimens.

The Essays competing for this Prize to be sent in on or before March 1, 1854.

*** Contributors of Papers are requested to retain Copies of their Communications, as the Society cannot be responsible for their return.

RULES OF COMPETITION FOR PRIZE ESSAYS.

1. All information contained in Prize Essays shall be founded on experience or observation, and not on simple reference to books or other sources.

2. Drawings, specimens, or models, drawn or constructed to a stated scale, shall accompany writings requiring them.

3. All competitors shall enclose their names and addresses in a sealed cover, on which only their motto, and the subject of their Essay, and the number of that subject in the Prize List of the Society, shall be written.*

4. The President or Chairman of the Council for the time being, shall open the cover on which the motto designating the Essay to which the Prize has been awarded is written, and shall declare the name of the author.

5. The Chairman of the Journal Committee shall alone be empowered to open the motto-paper of any Essay not obtaining the Prize, that he may think likely to be useful for the Society's objects; with a view of consulting the writer confidentially as to his willingness to place such Essay at the disposal of the Journal Committee.

6. The copyright of all Essays gaining prizes shall belong to the Society, who shall accordingly have the power to publish the whole or any part of such Essays; and the other Essays will be returned on the application of the writers; but the Society do not make themselves responsible for their loss.

7. The Society are not bound to award a prize unless they consider one of the Essays deserving of it.

8. In all reports of experiments the expenses shall be accurately detailed.

9. The imperial weights and measures only are those by which calculations are to be made.

10. No prize shall be given for any Essay which has been already in print.

11. Prizes may be taken in money or plate, at the option of the successful candidate.

12. All Essays must be addressed to the Secretary, at the house of the Society.

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* Competitors are requested to write their motto on the enclosed paper on which their names are written, as well as on the outside of the envelope.

Essays and Reports.—AWARDS, 1851–52.

FINLAY DUN, jun., Veterinary Surgeon, of Heriot Row, Edinburgh; the Prize of TWENTY SOVEREIGNS, for the best Essay on the Diseases of Farm Horses arising from Mismanagement.

WILLIAM CHARLES SIBBALD, Veterinary Surgeon, of Biggleswade, Bedfordshire; the Prize of TWENTY SOVEREIGNS, for the best Essay on the Diseases after Parturition in Cows and Sheep, with their Remedies.

EDWARD J. HEMMING, of Lismore, county of Waterford, Ireland; the Prize of TWENTY SOVEREIGNS, for the best Essay on any subject in Agricultural Chemistry.

JOSHUA TRIMMER, of Foden Bank, Macclesfield, Cheshire; the Prize of FIFTY SOVEREIGNS, for the best Report on the Agricultural Geology of England and Wales.

WILLIAM BEARN, of Handley Farm, near Towcester, Northamptonshire; the Prize of FIFTY SOVEREIGNS, for the best Report on the Farming of Northamptonshire.

THOMAS ROWLANDSON, of Brompton, Middlesex; the Prize of TEN SOVEREIGNS, for the best Essay on the Production of Butter.

WILLIAM DICKINSON, of North Mosses, near Cockermouth, Cumberland; the Prize of FIFTY SOVEREIGNS, for the best Report on the Farming of Cumberland.

HUGH RAYNBIRD, of Laverstoke, near Andover, Hampshire; the Prize of TWENTY SOVEREIGNS, for the best Essay on the Management of the Clovers, Rye-grass, &c., with the best remedy for Clover Sickness.

JOHN WILSON, of Iver, Buckinghamshire; the Prize of THIRTY SOVEREIGNS, for the best Account of the Manufacture of Sugar from Beet-root.

The following Official Documents may be had on application to the Secretary of the Society, at No. 12, *Hanover Square, London.*

I. Prize Sheet for Agricultural Implements } at the Gloucester Meeting in the week commencing 11th July, 1853.

II. Prize Sheet for Live Stock . . . . } at the Gloucester Meeting in the week commencing 11th July, 1853.

III. Prize Sheet of Essays and Reports to be sent to the Secretary by the 1st March, 1853.

IV. Terms of the Society's £50 Prize for Discovery of new Supplies of Guano.

V. Terms and Conditions of the Society's £1000 (and Gold Medal) Prize for Discovery of a Substitute for Guano.

VI. Members' Privileges in reference to Chemical Analyses.

VII. Members' Privileges in reference to Veterinary Inspection and Diseases of Cattle, Sheep, and Pigs.

VIII. Summary of Regulations having reference to Nomination, Election, &c. of Members.

IX. Bye-Laws of the Society.

*** The last day on which Implements can be entered for the Gloucester Meeting will be the 1st of May; and the last day of entry for Live Stock the 1st of June.

Royal Agricultural Society of England.

SUMMARY STATEMENT

OF

MEMBERS' CHEMICAL AND VETERINARY PRIVILEGES:

of which detailed printed statements may be had on application to the Secretary.

I.—Chemical Analyses:

at the following reduced rates to Members of the Society:

	£.	s.	d.
1. An opinion as to the genuineness of a manure in the market . .	0	5	0
2. Determination of ammoniacal matter, or earthy phosphates . .	0	10	0
3. Ascertaining the proportion of lime in a soil	0	7	6
4. Ascertaining the proportion of magnesia in a soil . . .	0	10	0
5. Ascertaining the proportion of lime and magnesia . . .	0	15	0
6. Analysis of limestone or marl	1	0	0
7. Partial analysis of a soil	1	0	0
8. Complete analysis of a soil	3	0	0
9. Letter asking advice on one topic	0	7	6
10. Letter asking advice on more than one topic	0	10	0
11. Analysis of oil-cake, dung, or any animal products . . .	1	0	0
12. Analysis of oil-cake, in reference to oil, &c.	1	10	0
13. Determination of amount of carbonate or sulphate of lime in water	1	0	0

*** All members wishing to avail themselves of these privileges are requested to place themselves in direct communication with Professor Way, the Consulting Chemist to the Society, whose address is No. 23, Holles-street, Cavendish-square, London.

II.—Diseases of Stock.

1. The remission of professional fees in such cases of outbreak of disease among the Live-Stock of Members as may be thought by the Veterinary Committee to be of sufficient importance to require the personal attendance of the Veterinary Inspector of the Society.
2. The payment, also, by the Society, of the Veterinary Inspector's travelling expenses in such special cases as the Veterinary Committee may consider it desirable for the promotion of the objects of the Society to sanction.
3. Leave for Members of the Society to send Cattle, Sheep, and Pigs to the Royal Veterinary College in London, on the same terms as if they were subscribers to the College.